

**BULLETIN OF THE
VANDERBILT MARINE MUSEUM**

VOLUME VII

Scientific Results of the World Cruises of the Yachts
"Ara" 1928-1929, and "Alva" 1931-1932, "Alva"
Mediterranean Cruise 1933, and "Alva"
South American Cruise 1935,
William K. Vanderbilt, Commanding

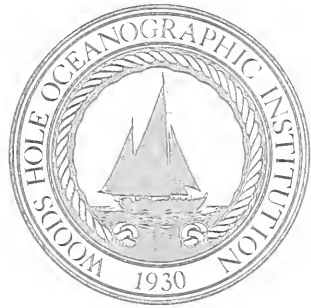
**MARINE ALGAE, COELENTERATA, ANNELIDA,
ECHINODERMATA, CRUSTACEA, MOLLUSCA**

By LEE BOONE

Gift of

Christina H. Hamm
The Vanderbilt Museum

November 1987



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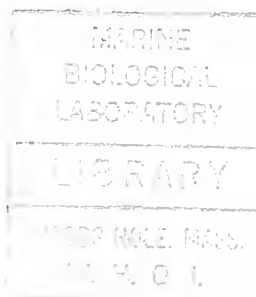
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William K. Vanderbilt, Commanding

MARINE ALGAE: CHLOROPHYCEAE AND CORALLINACEAE
COELENTERATA: HYDROIDA, LEPTOMEDUSAE, SIPHONOPHORA,
SCYPHOMEDUSAE, ALCYONACEA, PENNATULACEA,
ACTINARIA AND MADREPORARIA
ANNELIDA POLYCHAETA
ECHINODERMATA: ASTEROIDEA, CRINOIDEA, OPHIUROIDEA,
ECHINOIDEA AND HOLOTHUROIDEA
CRUSTACEA: ANOMURA, MACRURA, BRACHYURA, STOMATOPODA
AND CIRRIPIEDIA
MOLLUSCA: CEPHALOPODA, AMPHINEURA, GASTROPODA,
NUDIBRANCHIATA AND PELECYPODA

By LEE BOONE

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IN SALUTE TO THE
“ALVA”

*“In Nature’s infinite book of secrecy
A little I can read.”*

—SHAKESPEARE.

ANNOUNCEMENT

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The Vanderbilt Marine Museum is the privately owned depository of the marine collections of William K. Vanderbilt, Esquire, and is located on his country estate, "Eagle's Nest," Huntington, Long Island, New York. It contains extensive collections of natural history and ethnological specimens, all of which were personally collected by Mr. Vanderbilt during the past thirty-odd years.

The scientific publications of the museum consist of a series of Bulletins, designed to disseminate results of research based on the marine zoological collections, every specimen of which was personally collected by Mr. Vanderbilt during a series of cruises in his yachts, "Eagle," "Ara" and "Alva." Volume I of the Bulletin series consists of reports on the fishes collected during these cruises, by Dr. N. A. Borodin. Volume II consists of a report on the Stomatopod and Brachyuran Crustacea of the cruises of the yachts "Eagle" and "Ara," 1921-1928, by Lee Boone. Volume III consists of report of the Crustacea: Anomura, Macrura, Schizopoda, Isopoda, Amphipoda, Mysidacea, Cirripedia, and Copepoda, of the same cruises of the "Eagle" and "Ara." Volume IV consists of a report of the Coelenterata, Echinodermata and Mollusca of the cruises of the yachts "Eagle" and "Ara," 1921-1928, by Lee Boone. Volume V consists of a report on the Crustacea: Stomatopoda and Brachyura of the World Cruise of the yacht "Alva," 1931-1932, by Lee Boone. Volume VI treats of the Crustacea: Anomura, Macrura, Euphausiacea, Isopoda and Amphipoda, and of the Echinodermata; Asteroidea and Echinoidea of the World Cruise of the yacht "Alva," 1931-1932, by Lee Boone. Volume VII, the present report, discusses the Algae, Coelenterata, Annelida, Echinodermata, Crustacea and Mollusca of the World Cruise of the yacht "Ara," 1928-1929, part I, the World Cruise of the yacht "Alva," 1931-1932, part III, the "Alva" Mediterranean Cruise, 1933, and the "Alva" South American Cruise, 1935.

These Bulletins are available for distribution to scientific establishments by purchase, or by exchange for equivalent research reports in related subjects. They may be obtained by addressing Mr. Vanderbilt at the Vanderbilt Marine Museum, Huntington, Long Island, New York, U.S.A.

THE MARINE ALGAE, COELENTERATA, ANNELIDA
POLYCHAETA, ECHINODERMATA, CRUSTACEA
AND MOLLUSCA OF THE WORLD CRUISES OF THE
YACHTS "ARA," 1928-1929, AND "ALVA," 1931-1932,
"ALVA" MEDITERRANEAN CRUISE, 1933, AND
"ALVA" SOUTH AMERICAN CRUISE, 1935,
WILLIAM K. VANDERBILT, COMMANDING

by

LEE BOONE

This Bulletin, seventh in the scientific series of the Vanderbilt Marine Museum, contains reports on six separate groups of marine organisms, namely, Marine Algae: Chlorophyceae and Corallinaceae; Coelenterata: Hydroida, Leptomedusae, Siphonophora, Scyphomedusae, Alcyonacea, Pennatulacea, Actinaria and Madreporaria; Annelida Polychaeta; Echinodermata: Asteroidea, Crinoidea, Ophiuroidea, Echinoidea and Holothuroidea; Crustacea Decapoda: Anomura, Macrura, Brachyura, Stomatopoda and Cirripedia and Mollusca: Cephalopoda, Amphineura, Gastropoda, Nudibranchiata and Pelecypoda collections obtained on four separate expeditions made by Mr. William K. Vanderbilt in his yachts, "Ara" and "Alva." It is the third volume of the scientific series devoted to the Invertebrate collections obtained during the "Alva" World Cruise, 1931-1932, and contains the second report of the "Alva" Echinodermata, the third report on the Crustacea and the first reports on the Coelenterata, Annelida Polychaeta, Mollusca and Marine Algae of this cruise. In "West Made East with the Loss of a Day," a chronicle of the first circumnavigation of the globe under the United States Naval Reserve yacht pennant, July 7, 1931, to March 4, 1932,—An Account of Adventures in Navigation, Diversions, Picturesque Scenes and Every Day Life of Remote Places and the Taking of Specimens for the Vanderbilt Marine Museum, by William K. Vanderbilt in command of the Motor Ship "Alva," Mr. Vanderbilt has presented the narrative of this voyage in an exquisitely illustrated volume which includes maps of the itinerary, also many lovely color plates painted from living specimens by Mr. W. E. Belanske, under Mr. Vanderbilt's

direction. Volume V of the Bulletin series presented the Crustacea: Stomatopoda and Brachyura, and Volume VI, the Crustacea: Anomura, Macrura, Euphausiacea, Isopoda and Amphipoda and the Echinodermata: Asteroidea and Echinoidea of this "Alva" World Cruise.

The itinerary of this circumnavigation of the globe, a cruise of 28,182 miles, which began at Northport, Long Island, New York, thence to the "Alva" Base, Fisher Island, Miami, Florida, was via Cuba, and Jamaica, through the Panama Canal to the Perlas Islands, out to the Galapagos, then the Marquesas, Tamotu and Society Archipelagoes, Samoa, Fiji, New Caledonia and Great Palm Island, Australia, then leaving the Pacific, through Torres Straits, to Flores Strait, Sumbawa, Bali, Java, through the Banka and Malacca Straits, Indian Ocean and Arabian Sea to Aden, through the Suez Canal to the Mediterranean Sea, France, Spain, Gibraltar, Morocco, out to the Canaries and Cape Verde Islands, across the Atlantic via Porto Rico, home to Miami. The collections herein discussed were made in the beauteous coral reefs and fascinating tidal zone of the above archipelagoes and localities of the littoral zone of the Indo-Pacific region, that part of the world, oldest in human history, yet still a mystery even to students of science, who have spent their lives in research. The major deep-sea dredgings were made at stations in the Dutch East Indies, off the New Hebrides and off Marquesas Islands, in the Pacific, and off the Canaries, in the Atlantic Ocean and along the continental shelf of the southeastern United States.

The first reports on the same groups of Invertebrates, obtained during the World Cruise of the yacht "Ara," 1928-1929, is also incorporated in the present Bulletin. The journal of this voyage: "Taking One's Own Ship Around the World, a Journal descriptive of scenes and incidents together with observations from the log book recorded on the Voyage Around the World, October 25, 1928, to May 16, 1929, of the yacht "Ara," commanded by the author, has been delightfully told by Mr. Vanderbilt, in an exquisitely illustrated volume, which includes maps of the voyage and numerous color plates of the living specimens, painted by Mr. W. E. Belanske. The "Ara's" route via the Panama Canal traversed some of the most fascinating areas of the Pacific, the Hawaiian, Marshall, Caroline and Philippine Archipelagoes, thence returned home via Cochin China, the Straits Settlements, India, the Suez Canal, Greece, Italy and France, a voyage of 28,738 miles, during which explorations the sea yielded rich harvest of countless rare

and new marine specimens, whose living bodies bear palimpsest of an immemorial past. The principal deep-sea stations made by the "Ara" were in the south China Sea and regions adjacent to the Mindanao coast in Philippine waters. The scientific treasures of this cruise, which are discussed in detail, in the foreword of the respective systematic divisions of the reports, may be summarized by stating that rare species and new ones are of common occurrence, but common species are exceedingly rare.

Material secured by the "Alva" Mediterranean Cruise, 1933, which sailed from the "Alva" Base, Fisher Island, Miami, Florida, via the Bermuda Islands, across the Atlantic to the Mediterranean Sea, making collections at Santander and Almeria, Spain, Naples, and Venice, Italy, and Casa Blanca, Morocco, is also included in this Bulletin.

The "Alva" South American Cruise, 1935, left from her Base, Miami, made important deep-sea stations along the margin of the Pourtales Plateau, securing several hundred valuable specimens, many of which establish second records of Dr. Alexander Agassiz's Echinoderm types, also of Dr. Alphonse Milne Edwards' Crustacean types first collected by the United States Coast Survey steamer "Blake," thence proceeded through the Panama Canal to the Perlas Islands, where valuable specimens of Invertebrates were taken, then swung south, in the path of the Humboldt Current, exploring Ecuadorean, Peruvian and Chilean waters, which investigations yielded countless marine Invertebrate rarities, including the rediscovery of several of "lost" species of Crustacea, established by the Abbé Don Juan Molina, 1782, but so seldom represented in northern museum collections that they have been unrecognized by modern students. Other forgotten species rediscovered by the "Alva" include Anomuran Crustaceans, collected in the Chiloe Archipelago, Chile, first described by M. Guérin de Méneville, in his report on the "Crustacées du Voyage de la Favorite" (1835, also 1838). Brandt's rare Leptoline Medusa, taken only twice since he described it a hundred years ago in the "Mémoires de l'Académie impériale des Sciences de St. Petersbourg" from a station off the northwestern trend of the Humboldt Current, was found lazily drifting in Valparaíso Harbor, Chile, gigantic specimens, their crystalline blue bodies repeating the beauties of Merton's exquisite color-plate. From the muddy bottom of Reloncavi Inlet, Bahía de Cochamo, Chile, Dr. Alexander Agassiz's rare *Brisaster moseleyi*, first dredged by H.M.S. "Challenger," was taken in abundance by the "Alva."

The fresh-water Crustacean fauna of Peru is represented by one species of prawn which is also one of the oldest described Chilean crustacea, the "mason crab," *Cancer cementarius*, described in the Abbé Don Molina's "Natural History of Chile." (1776, anonymously, 1782 signed).

The annotated discussion of the species is presented with reference to their systematic classification. Geographical and bathymetrical distribution of the species is also given. The greater portion of the "Ara" and "Alva" Invertebrates herein discussed are very rare specimens, not at all, or very sparsely represented in any American museum, being hitherto known only from the types or a few specimens variously fifty to a hundred years old or even older, scattered in the museums of Asia, Australia, Oceania, Europe, Africa, South and North America. In addition to these rarities, numerous new species in several groups of Invertebrates were taken by the "Ara" and "Alva" and are deposited in the type series of the Vanderbilt Marine Museum. Concise discussion of the more significant rarities is given in the synopses of the respective systematic divisions of Invertebrates reported.

ACKNOWLEDGMENTS

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It is a pleasure to express my gratitude to Mr. Vanderbilt for his unfailing patience, helpful criticism and gracious generosity which has made the prosecution of this research an unforgettable privilege.

I am also indebted to Dr. Herbert Putnam, Librarian of Congress, and his staff assistants in the science, rare book and map divisions, for exceptional research privileges in this institution, and to my colleagues in the Asiatic, Australian, Oceanic, European, African, South and North American Museums for many helpful courtesies, particularly in the location and examination of rare materials and records. Mr. Ernest L. Crandall, of Washington, D. C., dean of the United States government photographic experts, personally made the photographs in his private studio. The illustrations were all made under my personal supervision; the line drawings being carefully done to scale and verified by two ladies who assist me. The Press of Whittet & Shepperson has been especially helpful in the preparation of the plates in this volume.

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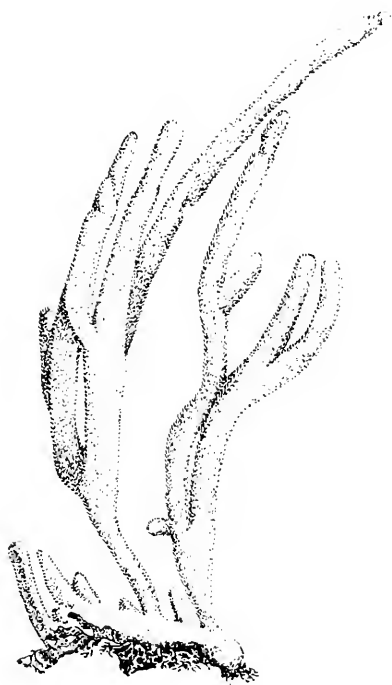
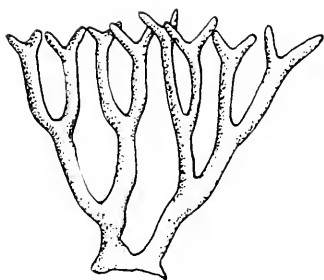
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Caulerpa webbiana Montague variety *tomentella* (Harvey): a, section of surculo supporting typical fronds, $\times 2$; b, ramuli from a typical frond, much enlarged; c, apical portion of a frond, showing ramuli and central axis, much enlarged.

SYSTEMATIC DISCUSSION

PART I

MARINE ALGAE

There were but two species of marine algae obtained by the "Alva" World Cruise of 1931-32, both of which were collected incidentally with marine invertebrates on Teviatea Reef, Raiatea Island, Society Islands. The first plant, *Caulerpa webbiana* Montagne variety *tomentella* (Harvey), a littoral, circumtropic species of the *Chlorophyceae*, is here reported for the first time from the Society Islands and is apparently the only published record of this variety in an American museum. A very fine cluster of *Cheilosporum sagittatum* Lamouroux, a remarkably beautiful calcareous algae, member of the *Corallinaceae*, establishes the first record in the Society Islands and greatly extends the known geographic range of this species to the eastward in the south Pacific. The present material is apparently the only specimen of *sagittatum* in an American depository.

Chlorophyceae

Siphonales

Family: CAULERPACEAE

Genus: CAULERPA Lamouroux

Caulerpa webbiana Montagne variety *tomentella* (Harvey)

✓

Plate 1

TYPE: The type of *C. webbiana* was collected in the Canary Islands and is deposited in the Paris Museum; the type of Dr. Harvey's *tomentella* came from the Tonga Archipelago and was deposited in his cabinet, Trinity College, University of Dublin.

DISTRIBUTION: This species, together with its several varieties, is practically circumtropic in the littoral zone, having been reliably recorded from the Canary Islands, the West Indies, especially the Virgin Islands, also at Pernambuco, Brazil, the Red Sea, Japan, Tongatabu and now from the Society Islands, the present

record being apparently the first for *tomentella* from this archipelago.

MATERIAL EXAMINED: One very fine cluster taken on Teviatea Reef, Raiatea Island, Society Islands, August 21, 1931.

TECHNICAL DESCRIPTION: The genus *Caulerpa*, which includes eighty-odd species, is the characteristic alga covering of the rocks and sands in the shallow water lagoons of the tropical seas. The members of the genus are widely scattered, giving it an extensive circumtropic distribution. There are also several species of fossil alga plants accredited to this genus.

The present subspecies, represented in the "Alva" collection by a large cluster of fronds, has the surculo robust, with but very few hairs, prostrate, creeping, the underside giving rise to small clusters of root-like fibers that attach to bits of sand, etc.; the upper surface of the surculo gives rise at short intervals to erect, stipitate fronds, the larger of which are frequently once branched. These fronds are two to three centimeters high, each supporting numerous ramuli arranged in continuous series around the central axis, these ramuli being dichotomous, each half being equally forked, Y-like, the distal ends of this Y being bifurcate, acuminate, as shown in figure B.

REFERENCES: *Caulerpa webbiana*, MONTAGNE, C., Ann. Sci. Nat., 2nd ser., t. IX, Botanique, Paris, 1838, p. 129 and 146, pl. 6, figs. 1-5.—MAZE, H., et SCHRAMM, A., Essai de Classification des algues de la Guadeloupe, 1865 et 1870, p. 77, Basse Terre.—AGARDH, J., Till Alg. Syst., 1872, Pt. I, Lund Univ. Arsskrift, vol. XIX, p. 7.—WEBER VAN BOSSE, A., Ann. Buitenzorg Jardin Bot., Leide, 1898, t. XV, p. 269.—BORGENSEN, F., K. Danske Vidensk. Selsk. Skr. 7 Rk. Naturv.—Math. Afd. IV, 5, 1907, p. 357; the Marine Algae of the Danish West Indies, vol. I, 1913-14, Chlorophyceae and Phaeophyceae, Copenhagen, p. 125.—F. S. COLLINS, Tufts College Studies, vol. II, No. 3, July, 1909, p. 412.

Chauvinia webbiana, KUTZING, F. T., Spec. Alg., p. 499, Tab. Phycol. 1857, vol. VII, tab. 6.

Caulerpa tomentella, HARVEY, W. H., List of Friendly Island Algae, AGARDH, J., loc. cit., p. 8.

Caulerpa webbiana variety *divergens*, AGARDH, J., loc. cit., p. 7.



Cheilosporum sagittatum Lamouroux, $\times 2$.



Cheilosporum sagittatum Lamouroux: a typical frond, showing the variation in articulation, also the occurrence of conceptacles, γ about 5.

Class: **Corallinaceae****CORALLINACEAE** *verae*Genus: **CHEILOSPORUM** Areshoug**Cheilosporum sagittatum** Lamouroux

1

Plates 2 and 3

TYPE: This was taken by the "Uranie" at Port Natal, South Africa and Mauritius, and deposited in M. Lamouroux's herbarium, which Mme. Weber van Bosse (1904) refers to as being at Caen.

DISTRIBUTION: Littoral zone, South Africa, at Port Natal and Algoa Bay (Lamouroux, Harvey; Swan River (Preiss) Kiama, New South Wales, on tidal rocks (Harvey); Society Islands (Boone).

Dr. Harvey refers to *Cheilosporum elegans* of New Zealand as "a very closely, perhaps too closely allied species," but states that it is a slenderer plant. The present writer, lacking additional specimens, refrains from comment, other than to note that extension of the geographical range eastward to the Society Islands, established by the "Alva" material, indicates that it is not improbable that *sagittatum* is to be found in New Zealand.

MATERIAL EXAMINED: One cluster, taken on Teviatoa Reef, Raiatea Island, Society Islands, August 21, 1931, by the "Alva."

COLOUR: Dr. Harvey gives an exquisite colour plate of this species (Phycol., Australia, London, 1865, pl. 250), which he describes as follows: "The colour, when growing, is a deep and rather bright purple red, which becomes duller on drying, and on exposure the colour fades to a chalky white."

TECHNICAL DESCRIPTION: The "Alva" plant is 4.2 centimeters high and in the preserved state forms a fan-shape tuft, composed of numerous delicate fronds, expanded as shown in plate 2. The fronds arise from a spreading, calcareous crust-like root or base. The fronds are flabelliform in outline and fastigate, stipitate, repeatedly, regularly dichotomous above the middle. The more proximal articulations are more obconical, with short, appressed, lateral lobes; the median and upper articulations are deeply sagit-



Text figure 1.—*Cheilosporum sagittatum* Lamouroux, distal section of frond, showing variation in articulation, also occurrence of conceptacles, \times about 10.

tate, compressed, with a faint midrib, their lobes are subulate, spreading, acute or subacute. The distal articulations of the branches and ramuli are obovate or obcordate. Conceptacles are present abundantly in the Raiatea Island specimen, especially towards the ends of the branches. These are ovoid, paired, one

in each lobe of the articulation, half or more immersed in the upper portion of the lateral lobes, the conceptacle aperture being flush with the upper margin of the lobe and circular in contour. Each conceptacle contains a tuft of four-jointed spore threads. When decalcified, the articulations show an exquisite design of alternate bands, composed respectively of roundish and of linear cells.

The variation in the articulations is well shown in the artist's sketch (figure 1, of the distal portion of a branch.)

- REFERENCES: *Corallina sagittata*, LAMOUROUX, J. V. F., in Freycinet, L. de, Voy. de L'Uranie et Physicienne Zool. (Quoy, J., et Gaimard, P., t. III, s. III, p. 625; Zool. Atlas, pl. 95, figs. 11, 12.
- Amphiroa sagittata*, DECAISNE, J., Ann. Sci. Nat., 1842, p. 359.— HARVEY, W. H., Nereis Australis, London, 1848-49, pl. I, p. 102.
- Cheilosporum sagittatum*, ARESHOUG, J. E., in Agardh, J. G., Spec., Gen. et Ord., Algarum, vol. III, 1851-52, p. 545.— HARVEY, W. H., Alg. Austral. Exsic. No. 445; Phycol. Australica, vol. V, 1863, pl. 250, figs. 1-5 and text adjacent.

PART II
COELENTERATA

1

PART II

COELENTERATA

The Coelenterata presented in this Bulletin of the Vanderbilt Marine Museum, seventh in the scientific series, are part of the collections obtained by Mr. William K. Vanderbilt in a series of cruises in his yachts "Ara" and "Alva," during the years 1928 to 1935. These explorations included the World Cruise of the "Ara," 1928-1929, the World Cruise of the "Alva," 1931-1932, and the "Alva" South American Cruise of 1935. Although numerically small, the collection is surprisingly rich in the number of new and rare species it contains, and in the related extension of knowledge of their geographical and bathymetrical distribution and of their anatomy, as presented in the systematic discussion.

Hydroida

The Hydroida are represented by only one species, *Corydendrium splendidum* Boone, from Oahu, Hawaii, a new Gymnoblastea, possessing stages of development seldom found. These were collected by the "Ara" World Cruise, 1928-1929.

Leptomedusae

The Leptomedusae are represented by two exceptionally large specimens of the exceedingly rare *Aequorea coerulescens* (Brandt) which were collected in Valparaiso, Chile, by the "Alva" South American Cruise of 1935.

Siphonophorae

The Siphonophorae obtained by the "Alva" World Cruise of 1931-32 consist of eight species, the record of each of which contributes something of value to our knowledge of this group of miraculously beautiful ocean dwellers.

The "Alva's" deep-sea station in the Atlantic Ocean, off Fuerte Ventura, Puerto Cabras, Canary Islands, depth 250 fathoms, yielded four species, namely: A series of specimens of *Doromasia picta* Chun, of especial interest in being from Chun's type locality;

a series including both the Eudoxid and polygastric generation of *Cuboides vitreous* Quoy and Gaimard, originally taken near the Straits of Gibraltar; a series of the nearly circumtropic *Hippopodius hippopus* (Forsk.) and representatives of the widely distributed *Agalma okeni* Eschscholtz.

The comparatively rare *Amphicaryon acaule* Chun is represented by a single colony from the "Alva" deep-sea station in the Pacific Ocean, north of Nuka Hiva Island, Marquesas Islands, depth 150 fathoms. Likewise a series of specimens of *Abylopsis tetragona* (Otto) was taken here.

A new locality was established for the widely distributed *Diphyes bojani* (Chun) by the netting of a series of specimens in the Flores Straits, in a depth of 140 fathoms.

The several specimens of *Porpema prunella* (Haeckel), also taken in the Pacific north of Nuka Hiva Island, give the third record of this curious species, from a point intermediate between the widely separated type-locality, in the Pacific, north of New Guinea, established by the "Challenger" and the more recent "Albatross" record of it from the tropical eastern Pacific, off the west coast of Peru.

Scyphomedusae

The Scyphomedusae collection of the "Alva" World Cruise, 1931-32, contains only five species, but includes in these the remarkable, gigantic *Versura palmata* Haeckel. Four of these species are members of the *Rhizostomae*, two of which, *Versura palmata* Haeckel and the exquisite small *Mastigias papua* (Lesson) were taken in Banka Straits, off Muntok Island. The specimens of *Versura palmata* are much the largest recorded of this magnificent species and are apparently the only specimens of it in an American museum.

Cephea cephea (Forsk.) from the Pacific Ocean, north of the Marquesas Islands, is represented by a valuable series of young specimens, which establish a new locality for the species and the second deposit of it in an American museum.

Stomolophus meleagris (L. Agassiz) from Conway Bay, Galapagos Islands, is of exceptional interest, since it is the first record of an adult from this Archipelago, from which locality Haeckel (1880) described a solitary larval specimen. The species, rather scarce on the West Coast of the Americas, and more abundantly

known on the southeastern coast of the United States and in Caribbean waters, is one of those highly specialized *Rhizostomata* that has not changed since the two oceans became separated by the elevation of the Isthmus.

The fifth medusa, *Pelagia noctiluca* (Forsk.) , a member of the *Semaeostomeae*, was taken in the Atlantic Ocean, near the Canary Islands.

The species of medusa are distributed as follows:

Pelagia noctiluca (Forsk.) , Atlantic Ocean, off Canary Islands.

Cephea cephea (Forsk.) , Pacific Ocean, north of Nuka Hiva Island, Marquesas Islands.

Mastigias papua (Lesson) , Muntok, Banka Island, Banka Straits, Dutch East Indies.

Versura palmata (Haeckel) , Muntok, Banka Island, Banka Straits, Dutch East Indies.

Stomolophus meleagris (L. Agassiz) , Conway Bay, Galapagos Islands.

Alcyonacea

The Alcyonacea are represented by four species of exceptional interest. *Lobularia ceylonicum* (Pratt) discovered by the Ceylon Pearl Oyster Fisheries Investigations of the Gulf of Manaar, and recorded only once since then, when it was taken by the "Siboga" at Jedan Island, Dutch East Indies, was taken by the "Alva" on Teviatoa Reef, Raiatea Island, Society Islands, in abundance, this material being the first deposited in an American museum. The geographic range of the species is extended by several thousand miles.

Three large colonies of *Alcyonium confertum* (Dana) were taken in the Fiji Islands and appear to be the first record of this interesting species, since Prof. Dana secured his type in this archipelago nearly a hundred years ago.

The "Ara" World Cruise obtained two new species of Alcyonacea. These include a new *Sarcophytum* unique in its spiculation, *Sarcophytum reticulatum* Boone from the littoral zone of Pulo Condore, Anambas Islands, and a new *Dendronephthya*, also from the south China Sea. *Dendronephthya rosamondae* Boone was dredged off Terampa Cove, Siantan Island, in 33 fathoms, a magnificent colony, remarkably beautiful.

Pennatulacea

There is but a single species present of the Pennatulacea; this was taken by the "Ara" World Cruise in Manila Bay, Philippine Islands. It is a magnificent colony more than a foot long, representing a new species, *Veretillum vanderbilti* Boone, a remarkable and somewhat perplexing species that contains characters hitherto found only in the genotype, a Mediterranean-Atlantic species, combining these with characters heretofore considered distinctive for several separate Indo-Pacific species.

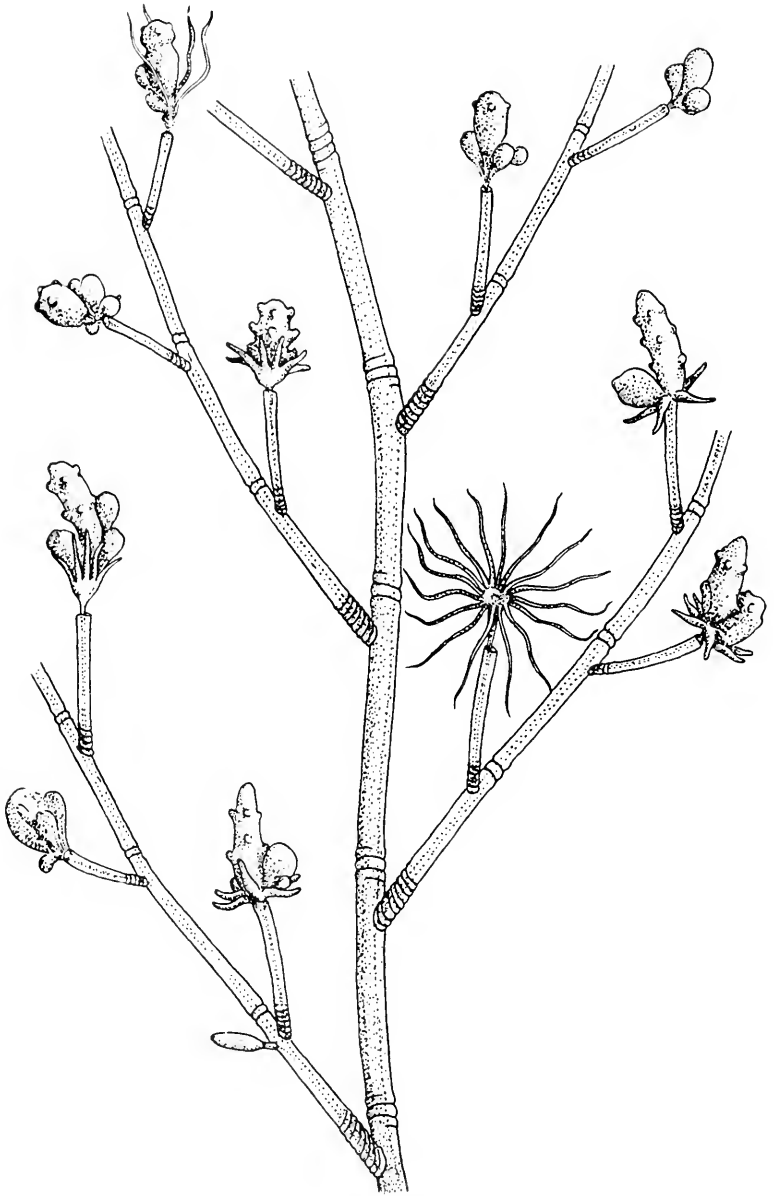
Actinaria

The Actinaria are represented in the collections of the "Alva" World Cruise of 1931-32 by two littoral species, one of which, *Gemmaria marquesana* Boone, a colony of approximately two hundred polyps attached to volcanic rock, taken in Anaho Bay, Nuka Hiva Island, is new to science. The second species, *Palythoa tuberculosa* (Esper), from the tidal zone of the Society Islands, is represented by an exceptionally fine colony of polyps. Although widely distributed in the Indo-Pacific, this primitive coral, which possesses such intensely interesting anatomy, appears to be very sparsely represented in museum collections. The "Ara" World Cruise, 1928-1929, also took this species in Kaneohe Bay, Hawaii.

The "Alva" World Cruise also secured a remarkably interesting series of fifty-odd specimens of the larval stages of *Peponactis aequatorialis* van Beneden in a deep-sea haul made north of the Marquesas Islands.

Madreporaria

Both the "Ara" World Cruise of 1928-1929 and the "Alva" World Cruise of 1931-1932 made extensive collections of exceptionally fine stone corals, discussed elsewhere. The two species herein reported were collected by the "Ara" in Hawaii and include the typical form of *Pocillopora cespitosa* Dana, which was first taken by the United States Exploring Expedition in this archipelago, and the very rare cluster coral, *Dendrophyllia manni* (Verrill), known only from Kaneohe Bay, Oahu, and represented in the Vanderbilt Marine Museum by the finest series of specimens recorded.



Corydendrium splendidum Boone, type, a portion of the colony showing the branching hydrocaulus, supporting hydranths in the various stages of development found, also the sporosacs; one of the rare, isolated gonophores, is shown on the lower left primary ramus.

COELENTERATA

Order: **HYDROIDA**

Family: **CLAVIDAE**

Genus: **CORYDENDRIUM** Van Beneden

Corydendrium splendidum, new species

1

Plate 4

TYPE: A large colony taken in one fathom, at low tide, in Kaneohe Bay, Oahu, Hawaiian Islands, December 15, 1928.

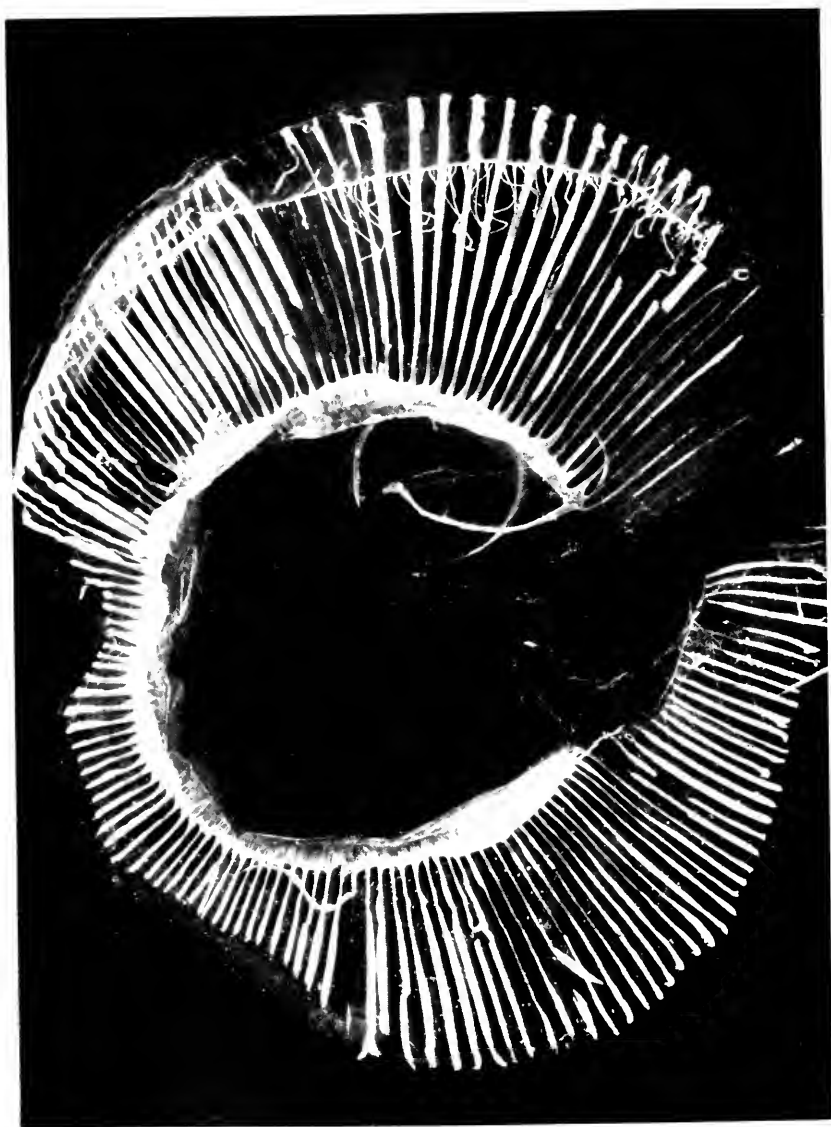
DISTRIBUTION: Littoral zone of Hawaii.

TECHNICAL DESCRIPTION: Trophosome: Colony with a strong creeping, much branched, netlike hydrorhiza which gives rise to a much branched hydrocaulus, fascicled at the base, attaining a height of five to six inches, the primary ramification irregular, but with the successive branches uniformly alternate and distichous in their division, giving rise throughout their length, on the exposed upper or distal sides, to short branches which support the hydranths on their tips. The perisarc is horn-like, firm, elastic; the primary stem annulated with two or three rings at each joint and the branches with six to eight rings at the origin of these and the yet smaller branches which are the hydrophore-like supports of the hydranths. These hydrophore-like branches may be distributed alternately to the left and right of the supporting branch, or irregularly if the latter arrangement achieves a more advantageous distribution. The hydrotheca have an elongated, narrowed, ovoidal body, with numerous short to medium length filiform tentacles irregularly distributed over the surface, these tentacles varying in the hydranths examined from four to six short, button-like protuberances encircling the distal end to sixteen to twenty tentacles of medium length irregularly distributed over the entire body; in those where the greatest tentacle development exists some of these tentacles form a simple, encupping circle around the base of the hydranth body and vary in length from one-third to one-half the length of the body; while above these, on the same body, shorter tentacles occur, in some instances nearly concealing the body, giving it a black-berry-like appear-

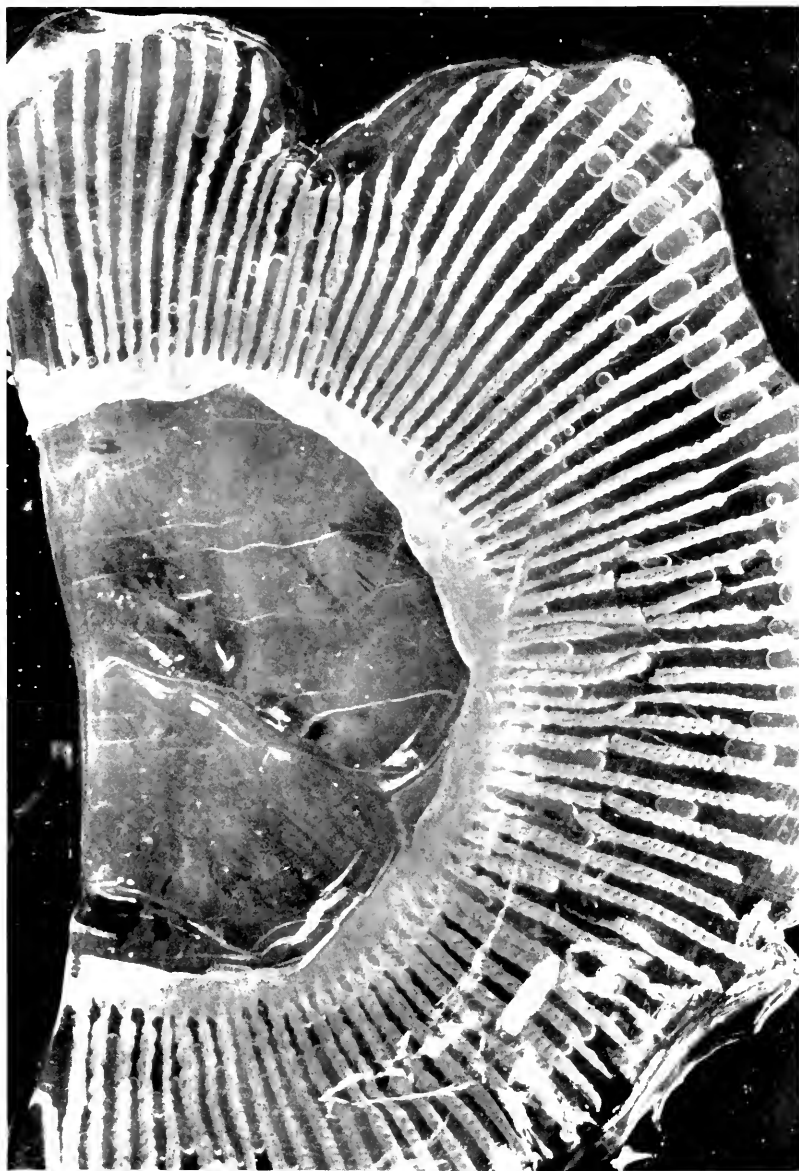
ance, created by the close grouping of the rounded tentacle-tips, (See pl. 4.). More frequently these small tentacles are sparsely distributed with much of the surface of the hydranth body visible. In a great many instances there arise from the identical hydrophore one, two or three globular or ovoidal shaped sporosacs; each of these is attached proximally by a thread, these threads converging and forming the attachment with the lumen of the hydrophore-like stem. None of the several hundred hydranths examined showed any indication of being capable of retraction within the hydrophore-like stem. The hypostome was found in varying degrees of extensibility and dilation; in some instances resembling a mere puckered distal end with a small aperture, in others a pair of lips surrounding a slit-like aperture, while in a few examples, completely dilated, the proboscis resembles distally a concave saucer-like form united proximally by a narrowed neck to the body, the whole having a vase-like profile.

GONOSOME: There are a few isolated gonophores present. Each of these is attached singly by a short peduncle to a primary lateral branch, a short distance below the distal end of a joint and adnate to the base of a smaller branch which forms the hydrophore, giving rise to a cluster of the numerous ovoidal sporosacs. These isolated gonophores are small, slender, narrowly ovoidal, proximally tapered and distally rounded, canary-yellow, with a shining surface, about 1 millimeter long with a maximum width diameter of about 0.4 millimeters.

The ovoidal sporosacs, which in the present colony are more numerous than the developed hydranths, arise in clusters of two, three, four, or much more rarely, six to eight, globular-ovoidal bodies, usually in various sizes and stages of development, each attached proximally by a filament, these threads forming a fascicle that extends within the lumen of the hydrophore. Not infrequently the degenerated tentacles of a hydranth occur at the base of such a cluster of sporosacs.



Acquorea coerulescens (Brandt), the smaller specimen taken in Valparaíso Harbor, Chile, about one-half of natural size, photographed from the dorsad of disk.



Acquorea coerulea (Brandt), slightly more than one-half of the larger specimen, taken in Valparaiso Harbor, Chile; about one-half of natural size, photographed from the dorsad of disk.

Order: **LEPTOMEDUSAE**

Family: **AEQUORIDAE**

Genus: **AEQUOREA** Péron and Lesueur

Aequorea coerulescens (Brandt)

1

Plates 5 and 6

TYPE: Brandt's type was taken in the Pacific Ocean, about Lat. 35° N., Long. 144° W., by Mr. C. H. Mertens, whose exquisite colour plates of this species apparently furnish the only colour record published. The type material is deposited in the Zoological Museum at St. Petersburg (Leningrad), Russia.

DISTRIBUTION: This exceedingly rare medusa is known only from the type locality, a fragmentary specimen from the Maldives, insufficient for positive identification (Bigelow, 1904), and one "large" specimen, 60 millimeters in diameter, from the "Albatross" station 4652, 100 fathoms to surface, and one specimen, 12 millimeters in diameter, from station 4655, 300 fathoms to surface, off Agudas Point, Peru, and the two specimens taken by Mr. Vanderbilt at Valparaiso, Chile.

MATERIAL EXAMINED: Two specimens, taken at Valparaiso, Chile, February, 1935, by the "Alva."

TECHNICAL DESCRIPTION: The larger specimen has a total diameter of 225 millimeters, a central mouth diameter of 75 millimeters and a radius of 75 millimeters for the area between the outer margin of the mouth and the circumferal margin. The smaller specimen has a total diameter of 225 millimeters, a central mouth diameter of 60 millimeters and a radius of 55 millimeters for the bell area between the outer margin of the mouth and the circumferal margin. These specimens are extremely interesting not only because of their great size, the larger one being 3.75 times the size of the largest one hitherto recorded (Bigelow, 1909), but because they establish the first Chilean record for a medusa for which the southernmost record has heretofore been off Agudas Point, Peru, (about 82° Long. W., 5° Lat. S.), thus extending our fragmentary knowledge of the Leptoline Medusae fauna of the tropical west coast of South America. It is significant that both

recent records of this exquisite medusa are within the range of the Humboldt Current. The gelatinous disk is a thick, plano-convex, with a diameter equal to one-third of the total diameter. Gastro-vascular system: The stomach is from one-third to one-half of the total diameter of the medusa, well developed in both specimens, although somewhat torn in the smaller specimen. The lower gastric wall is well developed in the larger specimen, with slight contraction, the mouth rather widely open. The lips, or oral prominences, appear to be about one-third as many as there are canals in the larger specimen. These vary in size, obviously due to the degree of contraction existent, from approximately the ratio Brandt (1838) illustrated in the type, to some slightly larger and others, smaller.

CANALS: The canals of the larger specimen are shown in pl. 6 and are of comparatively one size. The majority of the canals of the smaller specimen are moderately stout, approximately subequal, with others quite slender; there being no definite arrangement nor alteration of different sizes, such as is represented in Brandt's plate. In the present smaller specimen these canals show as thick or thin, in ratio to the degree of contraction existent, in part, and in part, to the position and light in which they are visible through the gelatinous substance. Critical examination of the uninjured canals show these to be approximately subequal. In the larger specimen these radial canals are all about equal and show in varying degree a puckered repetitional sinuate contour. The gonads are well developed.

OCTOCYSTS: These are very numerous, frequently double octocysts occur; all are closely crowded among the tentacles.

TENTACLES: These are almost entirely absent in the larger specimen, which is imperfect marginally, except for a space of about 12 millimeters width. About half of the circumferal margin is present in the smaller specimen where a fairly constant repetition of four to six tentacles per radial section between two canals occurs; these tentacles are of different sizes due to growth stages, the longest ones not exceeding 18 millimeters in the contracted state, the majority being 10 to 12 millimeters long; all are very slender. The tentacular bulbs are long, laterally compressed, only moderately dilated, of subovoidal form, or appearing in contour as irregularly oval, more narrowed distally than proximally. Each tentacular bulb communicates at the base on the inner side with

a conspicuous excretory papilla. The tentacular bulbs are distinctly darker, approaching a bluish black. In the larger specimen, the canals and gonads show a deep ivory yellowish tone; while in the smaller specimen these merely show as opaque creamy lines through the gelatinous bell.

COLOUR: The bell is opalescent, transparent gelatinous, somewhat crystalline. Canals with gonads show deep ivory yellow, otherwise they show an opaque creamy line.

REFERENCES: *Mesonema coerulescens*, BRANDT, J. F., Mem. Sci. Math., St. Petersburg, 1838, p. 360, pl. 5, (colour plate by Mertens).

Aequorea coerulescens, BIGELOW, H. B., Mem. Mus. Comp. Zool., 1909, vol. XXXVII, pl. 4, fig. 4, and pl. 35, figs. 3-8.

Order: CALYCOPHORAE

Family: SPHAERONECTIDAE

Subfamily: Muggiinae

Genus: DOROMASIA Chun

Doromasia picta Chun

†

TYPE: Dr. Chun's type series was secured in the Canary Islands; it included a good series of living specimens. The depositary is not stated.

DISTRIBUTION: A deep-sea species found in the warm regions of the Atlantic Ocean and in the tropic Pacific, Malaysia and Indian Ocean.

MATERIAL EXAMINED: The "Alva" specimens are twelve in number, with five additional partially destroyed specimens; the largest one is 26 millimeters long. They were taken in 250 fathoms, off Puerto Cabras, bearing 270° true, 7 miles distant, Fuerte Ventura, Canary Islands, February 18, 1932.

COLOUR: Transparent milky with touches of yellow on the internal organs.

LIFE HISTORY: Imperfectly known.

TECHNICAL DESCRIPTION: Consult *Doromasia picta* Chun, C., Senckenb. Naturf. Gesellsch., Abh., 1892-95, p. 91, pl. 8, figs. 3-5, pl. 9, figs. 5-10, pl. 10, figs. 1-9.

The complete specimens in the "Alva" series conform in every way with Dr. Chun's excellent description and exquisite illustration of this siphonophore. Variation in the extent of dentition occurs along the lateral ridges of the prismatic nectophore, in the present series of specimens. One of the largest specimens, with the nectophore 24 millimeters long, has these ridges serrate throughout their length; another nectophore, 16 millimeters long, has some of the ridges entirely serrate, others smooth. Very small nectophores, from 10, 12 to 14 millimeters long, do not have any more serration than is shown in plate 8, figure 3, of Chun's type illustration.

REFERENCES: *Doromasia picta*, CHUN, C., Senckenb. Naturf. Gesellsch., Abh. 1892-95, p. 91, pl. 8, figs. 3-5, pl. 9, figs. 5-10, pl. 10, figs. 1-9.—BIGELOW, H. B., Mem. Mus. Comp. Zool., 1911, vol. XXXVIII, p. 346, also see p. 264, (with extensive synonymy).

Genus: CUBOIDES Quoy and Gaimard

Cuboides vitreus Quoy and Gaimard

✓

TYPE: Quoy and Gaimard's type of the Eudoxid was secured in the Strait of Gibraltar by the "Astrolabe," in May, 1826, and is deposited in the Paris Museum.

Chun's type of the polygastric series was secured in the Canary Islands; the depository was not given.

DISTRIBUTION: This species is reliably known from the tropic Atlantic from the Canary Islands to the West Indies and also from the Indian Ocean (Huxley), the Malaysian region (Lens and Van Riemsdijk) and is abundant in the eastern tropical Pacific (Bigelow).

MATERIAL EXAMINED: One Eudoxid and one representative of the polygastric generation from off Fuerte Ventura, Puerto Cabras, Canary Islands, bearing 270° true, 7 miles distant, depth 250 fathoms, February 18, 1932.

TECHNICAL DESCRIPTION: Consult Chun (1892). The present specimens, also from the Canary Islands, are identical with those described by Dr. Chun from this locality.

REFERENCES: *Cuboides vitreus*, QUOY AND GAIMARD, Ann. Sci. Nat. Paris, t. X, 1827, p. 19, pl. 2, E, figs. 1-3.

Eudoxid, BIGELOW, H. B., Mem. Mus. Comp. Zool., 1911, vol. XXXVIII, No. 2, p. 190, (with extensive synonymy).

Halopyramis adamantina, CHUN, C., Sitz. Akad. Wiss. Berlin, Bd. XLIV, 1888, p. 1155; Abh. Senckenb. Nat. Ges. Bd. XVIII, 1892, p. 11, taf. 10, fig. 10, taf. 12.

Cuboides adamantina, CHUN, C., Ibid, p. 112.

Family: **PRAYIDAE**

Subfamily: **Amphicaryoninae**

Genus: **AMPHICARYON** Chun

Amphicaryon acaule Chun

✓

TYPE: Dr. Chun's type material was taken in the vicinity of the Canary Islands.

DISTRIBUTION: This species has been recorded twice from the Atlantic Ocean, namely, in the vicinity of the Canary Islands and possibly also Bermuda (Chun); while Dr. Bigelow reported it from the West Indies and from the tropical eastern Pacific seven specimens were taken at seven "Albatross" stations in depths ranging from 300 fathoms to surface.

MATERIAL EXAMINED: One young colony, taken in 150 fathoms, north of Nuka Hiva, Marquesas Islands, August 11, 1931, by the "Alva."

REMARKS: This young colony, the only one taken in a large haul of plankton, is like the specimen from the tropical eastern Pacific shown in Dr. Bigelow's plate 4, figures 1 to 8. The present specimen is quite young but shows clearly the short corm with its appendages and the canal system of the two nectosarcs is traceable. This colony has a long diameter of 3.5 millimeters and shows the older nectosarc but little larger than the younger.

REFERENCES: *Amphicaryon acaule*, CHUN, C., Sitz. Akad. Wiss. Berlin, Bd. XLIV, 1888, p. 1162.—BIGELOW, H. B., Mem. Mus. Comp. Zool., 1911, vol. XXXVIII, p. 195, pl. 4, figs. 1-8.

Mitrophyes peltifera, HAECKEL, E., Rept. Voy. H. M. S., "Challenger" Zool., vol. XXVIII, 1888, p. 131; Jena Zeit. f. Naturwiss., 1888, p. 34.—CHUN, C., Ergeb. der Plankton Exp., II, K.-b., 1897, 1888, p. 102.

Family: HIPPOPODIIDAE

Genus: HIPPOPODIUS Quoy and Gaimard

Hippopodius hippopus (Forsk.), s. s. Schneider

†

TYPE: Forskal's type is no longer extant.

DISTRIBUTION: This species is well known in the Atlantic from the West Indies eastward to the coast of Europe, also in the Mediterranean Sea. It is also known from one record in the Malaysian region (Lens and Van Riemsdijk) and is generally distributed in the eastern tropical Pacific (Bigelow). Bathymetric occurrence: surface to 400 fathoms.

MATERIAL EXAMINED: Ten detached nectophores, the largest one being 12 millimeters long, the smallest one about 3 millimeters long, the remainder being a series intermediate between these two. These were taken in 250 fathoms, about seven miles off Fuerte Ventura, Puerto Cabras, Canary Islands, February 18, 1932.

TECHNICAL DESCRIPTION: Numerous excellent descriptions and illustrations of this species are cited by Bigelow (1911).

REFERENCES: *Gleba hippopus*, FORSKAL, P., Icones rerum naturalium quas in itinere orientali, 1776, Hauniae, p. 14, taf. 43, fig. 1.

Hippopodius hippopus, SCHNEIDER, K. C., Zool. Anz., Bd. XXI, 1898, p. 82.—BIGELOW, H. B., Mem. Mus. Comp. Zool., 1911, vol. XXXVIII, p. 208 (with extensive synonymy).

Family: **DIPHYIDAE**

Subfamily: **Abylinae**

Genus: **ABYLOPSIS** Chun

Abylopsis tetragona (Otto)

↑

REMARKS: For discussion of this species refer to Volume IV, Bulletin of the Vanderbilt Marine Museum, p. 36. The present series of specimens, from near the Marquesas Islands, agree closely in all essentials with the "Ara" series, previously reported (1933), from 400 fathoms depth, off St. Raphael, France, in the Mediterranean Sea.

The seven superior nectophores of the Marquesas Islands series, range from four to six millimeters long, while the free Eudoxids are 3 to 4 millimeters wide.

All stages of this species have been well described and illustrated. The diagnostic features distinguishing *tetragona* from *eschsoltzi*, the only other species with which it is likely to be confused, have been given in the writer's earlier account.

MATERIAL EXAMINED: Seven superior nectophores and five free Eudoxids, taken in a plankton haul, from 150 fathoms to surface, north of Nuka Hiva Island, Marquesas Islands, August 11, 1931.

REFERENCES: *Pyramis tetragona*, OTTO, A. W., Nova Acta Caes. Leop. Carol., 1823, vol. XI, p. 306, taf. 42, figs. 2a-2c, 1883.
Abylopsis tetragona, BIGELOW, H. B., Mem. Mus. Comp. Zool., vol. XXXVIII, 1911, p. 224, pl. 14, figs. 6, 7 and pl. 15, fig. 2.

Subfamily **Diphyopsiinae**

Genus: **DIPHYES** Cuvier

Diphyes bojani (Chun)

↑

TYPE: This was taken between Hawaii and the Caroline Islands. The depository is not stated.

DISTRIBUTION: This species is known from the tropical Indo-Pacific, in depths varying from the surface to 300 fathoms. In

addition to the type locality, it was secured by the "Siboga" in the Malaysian region and by the "Albatross" in the Eastern Pacific, from off Manzanilla, Mexico, southward off the coast of Central America, as far as Guatemala, abundantly in the Galapagos Archipelago, both within and without the Humboldt Current, but it is not yet recorded from the Panamic region.

MATERIAL EXAMINED: Fourteen superior nectophores and a colony with two nectophores still connected, dredged in 140 fathoms, in Flores Straits, near Larantuka Village, Flores Island, Dutch East Indies, November, 1931.

The smallest specimen is 5 millimeters long and one of the largest nectophores is 12 millimeters long. The remainder form a series intermediate in size between these two, with more than half the collection in the longer group.

The excellent description of this species by Chun (1892), augmented by Bigelow's discussion (1911), makes further analysis unnecessary.

REFERENCES: *Doromasia bojani*, CHUN, C., Abh. Senckenb. Nat. Ges. 1892, Bd. XVIII, pp. 108, 110, fig. 8.

Diphyes bojani, BIGELOW, H. B., Mem. Mus. Comp. Zool., 1911, vol. XXXVIII, p. 232, pl. 7, figs. 2, 3, pl. 8, fig. 6, pl. 9, figs. 1, 2, pl. 10, figs. 2, 3, pl. 11, fig. 5, pl. 12, fig. 1, (with synonymy).

PHYSOPHORAE

Family: AGALMIDAE

Genus: AGALMA Eschscholtz

Agalma okeni Eschscholtz

1

TYPE: This is simply recorded as being from the South Seas.

DISTRIBUTION: This *Calycophora* is very widely distributed in the warmer regions of the Atlantic, Pacific and Indian Oceans and also in the Red Sea. It does not seem to be known from the Mediterranean to date.

MATERIAL EXAMINED: A portion of the siphonophore with two mature bracts attached and also the pneumatophore and a cor-midium with the siphon, tentacles, several palpons, female and male gonodendra. The bracts are each about 5.5 millimeters long. The "Alva" specimens were collected in 250 fathoms, about seven miles off Fuerte Ventura, Puerto Cabras, Canary Islands, in the Atlantic Ocean, February 18, 1932.

COLOUR: In the living specimens the pneumatophore has pigment spots of reddish purple, the stem opaque white or yellow, the tentilla brilliant brick-red.

REMARKS: For full description of this species consult Dr. H. B. Bigelow (1911, p. 281), whose analyses of an extensive series of living specimens, obtained by the "Albatross" expedition to the tropical eastern Pacific as well as West Indian material from other sources have greatly augmented our knowledge of this remarkable species, first described by Eschscholtz (1825), and more fully described and illustrated by Haeckel (1869, also 1888), from collections from the North Atlantic area and from Ceylon.

Agalma okeni is easily distinguished from its congeners by its characteristic form and habit of floating horizontally in the water. The largest colonies recorded range from 95 to 60 millimeters and many much smaller. The stem is short, non-contractile, the bracts are stiff, closely crowded in exceedingly precise and regular arrangement, prismatic in outline and roughly triangular, thickest at the distal end.

REFERENCES: *Agalma okeni*, ESCHSCHOLTZ, FR., Isis von Oken, 1825, vols. 16-17, p. 733-47, t. 5.—BIGELOW, H. B., Mem. Mus. Comp. Zool., 1911, vol. XXXVIII, No. 2, The Siphonophorae, p. 277, pl. 17 (extensive synonymy and full illustrations, also analyses of large collection of living specimens).

Crystallodes rigida, HAECKEL, E., Utrechter Gesell. Kunst. u. Wiss., 1869, p. 49, taf. 5, p. 65-71; Jena Zeit. Naturwiss. 1888, p. 40.

CHONDROPHORAE

Family: PORPITIDAE

Genus: PORPEMA Haeckel

Porpema prunella (Haeckel)

1

TYPE: Dr. Ernst Haeckel, professor of Zoology in the University of Jena, found this species in 1888, on the young stages only, taken by the "Challenger" at station 222, north of New Guinea, in the Pacific Ocean and also at station 288, in the South Pacific, in 2600 fathoms and deposited in the British Museum of Natural History.

Dr. H. B. Bigelow (1911) described the adult forms from an extensive series of specimens taken by the "Albatross" in the tropical eastern Pacific, at stations 4685 and 4686, and deposited in the United States National Museum and the Museum of Comparative Zoology.

DISTRIBUTION: This species, originally reported from the Pacific Ocean, north of New Guinea, at the surface, and more recently taken by the "Albatross," in the tropical eastern Pacific, off the west coast of Peru, about Long. 95°, Lat. 21° S., in quantity, was taken by the "Alva" north of the Marquesas Islands, in a 150 fathoms-to-surface haul. The record is of interest, being a station intermediate between the widely separated earlier records.

MATERIAL EXAMINED: A corm practically denuded of tentacles and gonozooids, this corm diameter being 2.5 millimeters preserved specimen; a second corm 2 millimeters wide; another corm with the bell broken but with several tentacles attached, also a few gonozooids, this corm about 2.5 millimeters wide; three more corms with broken bells, two separate pieces of tentacle base, also a separate contracted gonozooid, all taken in plankton, haul from 150 fathoms to surface, north of Nuka Hiva Island, Marquesas Islands, August 11, 1931.

REFERENCES: *Porpalia prunella*, HAECKEL, E., Jena Zeit. f. Naturwiss. Berlin, 1888, p. 30; Rept. Voy. H. M. S. "Challenger" Zool., 1888, vol. XXVIII, p. 58, pl. 48.

Discalia medusina, HAECKEL, E., loc. cit. A, p. 20; loc. cit. B, p. 46, pl. 49, figs. 1-6.

Porpita globosa, SCHNEIDER, K. C., Zool. Anz., Bd. XXI, 1898, p. 195, *partim*.

Porpema prunella, BIGELOW, H. B., Mem. Mus. Comp. Zool. vol. XXVIII, 1911, p. 325, pls. 25, 26, 27, pl. 28, figs. 11, 15 (excellent description, based on an extensive series of adult forms).

SCYPHOMEDUSAE

Order: SEMAEOSTOMEAE

Family: PELAGIDAE

Genus: PELAGIA Péron and Lesueur

Pelagia noctiluca (Forskal)

1

TYPE: Forskal's type came from the Mediterranean Sea and was deposited in the Copenhagen Museum.

DISTRIBUTION: This very beautiful medusa is pelagic in the open seas of a very wide area of the Mediterranean and the warm regions of the Atlantic Ocean. Curiously it is sometimes locally abundant in the Mediterranean for several successive seasons and then, without apparent cause, vanishes for several seasons. It has been extensively studied at the Bay of Naples where it is especially abundant in summer but the larger specimens of it are seldom recorded there in winter.

MATERIAL EXAMINED: One young specimen, taken in 250 fathoms, off Fuerte Ventura, Canary Islands.

LIFE HISTORY: The development of this species is most unusual, being direct, without a sessile larval stage. It has been exhaustively studied by Krohn (1855), Kovalevski (1873), Hamann (1883), Goette (1893), Hyde (1894) and Mechnikov (1886).

The structure of the gonads was examined critically by the two Hertwigs (1878) and the development of the gonads by Hamann (1883). These organs first appear in the entoderm of the subumbrella as four interradiar, elongate ridges. The entoderm develops

a series of follicles in which the sex cells develop and then migrate into a gelatinous lamella situated between the layers of entoderm.

The egg is violet brown according to Mechnikov. Complete and nearly equal segmentation occurs and a very large, central segmentation cavity results. Invagination at the posterior end of the body forms the gastrula; the blastopore remains open, forming the mouth of the larva. The mouth is of ectodermal origin and forms by invagination of the posterior end of the larva but this invaginated sac fills only a limited portion of the segmentation cavity. The first pair of stomach pouches are entodermal and situated diametrically opposite each other. The second pair are ectodermal and placed one each halfway between the first pair. The entodermal pair develop two lateral pouches each; and later the endodermal pair also develop two lateral pouches each; thus the larva has six ectodermal and six entodermal stomach pouches. Next the ectodermal pouches develop four new adradial pouches, giving the larva sixteen stomach pouches, ten of ectodermal and six of entodermal origin.

The external characters of the transformation of this free swimming larva have been reported by Krohn, Kovalevski and more recent writers. The larval mouth-end expands crater-like with the mouth at the summit of this central zone. The subumbrella develops from the depressed region around the cone. The lappets grow out around the margin of the gastrovascular cavity. At about this stage the larva loses the body covering of cilia and then swims by rhythmical contraction of the oral disk, the free swimming scyphostoma becoming an adult medusa without strobilization.

TECHNICAL DESCRIPTION: Numerous excellent descriptions of the adult medusa are available. The single specimen taken by the "Alva" off the Canary Islands is 20 millimeters diameter in the preserved state, or about one-third the size of the average adult specimens taken in the Mediterranean. The bell (preserved specimen) is subhemispherical with the apex flattish, the sides relatively straight, sloping. The exumbrella has numerous verrucae, arranged in irregular radiating series from the aboral center of the exumbrella; these verrucae become less mammiiform, more oval and smaller toward the margin. Eight tubular, tapering tentacles are present, each averaging a length equal to twice the

width diameter of the bell. Eight marginal sense organs are present set in deep niches, interradian and perradian. The sense club has no ocellus, having only a terminal, crystalline, orange-colored concretion mass. There is no sensory pit in the exumbrella above the sense club. There are sixteen marginal lappets, each being subrectangular with rounded angles and shallow median notches. The four-sided throat-tube is one-half as long as the bell diameter and the four lanceolate palps, each with their multi-folded margins are about one and one-third times the bell diameter. The outer edges of the palps have verrucae similar to those of the exumbrella.

COLOUR: The bell of the medusa is rose tinged with light lavender, this purplish tone deepening in the gonads and tentacles. The verrucae of the exumbrella and palps are brownish-orange-red.

REFERENCES: *Medusa noctiluca*, FORSKAL, P., Descript. Anim. Itin. Orient., 1775, p. 109.

Pelagia noctiluca, PERON, F., et Lesueur, C. A., Ann. Mus. Hist. Nat. Paris, 1809, t. XIV, p. 350.—KROHN, A., in Muller's Archiv. Anat. Physiol., 1855, p. 491, taf. 20, (discusses development).—HAECKEL, E., Densksch. Med.-Naturwiss. Gesell. Jena, Syst. der Medusen, 1880, Bd. I, p. 505 (with extensive early synonymy).—KOVALEVSKI, A. O., Mem. Imp. Soc. Lovers of Nat. Hist. Moscow, 1873, t. X, pt. II, p. 7, pl. 3, (discusses development).—HAMANN, O., Zeit. f. Wissensch. Zool., 1883, Bd. XXXVIII, p. 422, taf. 32, (development and structure of gonads).—MECHNIKOV, I. I., Embryol. Studien Medusen, Wien, 1886, p. 24 (egg), p. 67 (segmentation), p. 100, (larva), taf. 10, figs. 23-28.—Monaco, Prince Albert of, presented by Edwards, A. M., Compt. Rend. Sci. Paris, 1887, to. CIV, p. 452, (swarming habits of this medusa).—VANHOFFEN, E., Bibliotheca Zoologica, 1888, heft No. III, p. 8, taf. 1, figs. 5, 6, taf. 6, figs. 1-5; Deutsch. Sudpolar Exped. 1901-03, Bd. X, Zool. II, p. 38.—GOETTE, A., Zeit. f. Wissensch. Zool., 1893, Bd. LV, fig. 11, taf. 30-31; Sitzber. Akad. Wissensch. Berlin, 1893, p. 853 (development).—SHAXEL, J., Zool. Anz., 1910, Bd. XXXV, p. 407 (histology of oogenesis).—MAYER, A. G., Medusae of World, Carnegie Inst. Wash. Publ. 109, vol. III, 1910, p. 572, pl. 60, figs. 1-3, colour.

Order: RHIZOSTOMAE Cuvier

Rhizostomata dichotoma Vanhoffen, emended, Mayer

Genus: CEPHEA Péron and Lesueur

Cephea cephea (Forsk.)

✓

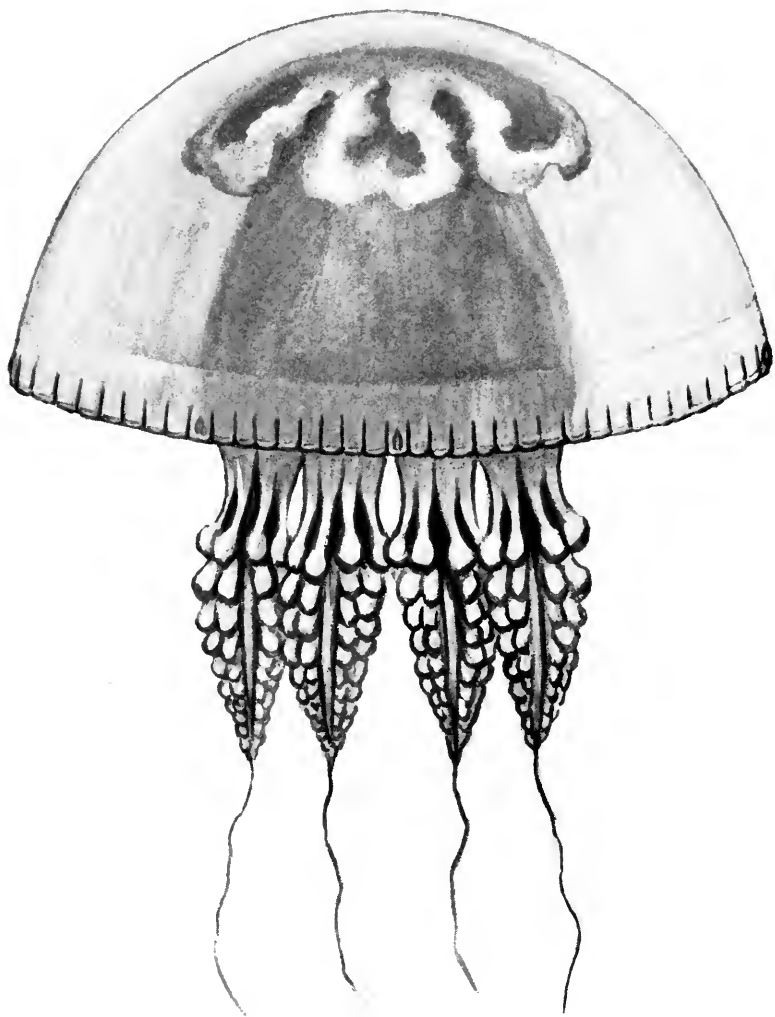
TYPE: Forskal's type was secured in "Djiddae" and deposited in the Royal Zoological Museum, Copenhagen.

DISTRIBUTION: According to the various specialists working with this group, this species and its several subspecies are widely distributed in the Indo-Pacific, it having been recorded from the Red Sea (Forsk.), eastward to Malabar (Péron and Lesueur), northward as far as Misaki, Japan, in winter, east to northwestern Australia (Péron and Lesueur), Samoa (Haeckel), near the Marquesas Archipelago (Boone) and the Hawaiian Archipelago (Agassiz; Mayer).

MATERIAL EXAMINED: Eight young specimens, taken in 150 fathoms, north of Nuka Hiva Island, Marquesas Islands, August 11, 1931, by the "Alva."

TECHNICAL DESCRIPTION: There are several excellent descriptions of this species and varieties based on large adult, living specimens. The "Alva" catch are all young, the smallest jelly-fish measuring 10 millimeters diameter, the largest one 22 millimeters diameter, the other six varying from 15 to 21 millimeters diameter. These are particularly interesting in showing a serial variation in the wart-like ornamentation of the bell dome, but possessing a constant identity with the other specific characters. In the specimen 10 millimeters diameter, the dome is flattish and its entire dorsal surface is regularly dotted with small, granular dots, a few of which, about thirteen, incompletely ring the area which becomes the typical dome. The ring furrow is incipient. There are sixteen divisions of the marginal zone, thickened, opaque, and sixteen long filaments. The subumbrella is developed, gelatinous, and the characteristic long, tubular filaments are present.

In the specimen 15 millimeters diameter, the dome is present, well developed, with the near marginal warts reduced, the central dome more definitely defined and the warts here longer, larger, mammiform and more numerous and closely crowded. In the speci-



Mastigias papua (Lesson), $\times 1.2$.

men 22 millimeters diameter, the warts of the central dome are crowded, elongated, mammiform, much as those shown in Kishinouye's figures of "*Perirhiza nematophora*" (Journ. Coll. Sci. Tokio, 1902, vol. XVII, pl. 2). This, the largest of the "Alva" specimens, has the marginal lappets and is quite typically developed.

- REFERENCES: *Medusa cephea*, FORSKAL, P., Descript. Anim. Itin. Orient., 1775, p. 108, No. 22; Icon., tab. 30.
- Medusa octostyla*, LINNÉ, C. (Gmelin, J. F.), Syst. Nat., 1788, ed. XIII, par. 6, p. 3157.
- Cephea rhizistomoidea*, PÉRON, F., et Lesueur, C. A., Ann. Mus. Hist. Nat. Paris, 1809, t. XIV, p. 361, No. 100.
- Polyrhiza cephea*, AGASSIZ, L., Contrib. Nat. Hist. U. S. Smithsonian, 1862, vol. IV, p. 156.
- Diplophilus couthouyi*, AGASSIZ, L., op. cit. p. 158.
- Cephea forskalea*, HAECKEL, E., Syst. der Medusen, Dansk. Med.-Natur. Gesellsch. Jena, 1879-1880, p. 574.
- Cephea conifera*, HAECKEL, E., op. cit. p. 576, taf. 36, figs. 3-8.
- (?) *Cephea fusca*, PÉRON, F., et Lesueur, C. A., op. cit. 1809, p. 361, No. 99.
- (?) *Cassiopea fusca*, DUSIMUER, M., 1835, Musée du Jardin des Plantes, No. 111.
- Perirhiza nematophora*, KISHINOUE, K., Journ. Coll. Sci. Tokio, 1902, vol. XVII, art. 7, p. 14, pl. 2, figs. 11-13.
- Cephea cephea*, MAYER, A. G., Carnegie Inst. Washington, Publ. 109, 1910, Medusae of the World, vol. III, Scyphomedusae, p. 654.

Rhizostomata triptera Vanhoffen

Genus: MASTIGIAS L. Agassiz

Mastigias papua (Lesson)

1

Plate 7

TYPE: M. Lesson first described and exquisitely illustrated this species from material secured by the "Coquille" in Offack Bay, Waigiou and Dorey Harbor, New Guinea, and deposited in the Paris Museum collections.

DISTRIBUTION: This pelagic species is widely distributed in the Indo-Pacific, having been reported from the east coast of Africa, the Indian Ocean, the Malay Archipelago, the China Sea northward to Japan and outward through Malaysia in the Pacific Ocean as far as the Fiji Archipelago. The species possesses much variation which has resulted in the recognition of three or more varieties, namely, Vanhoffen's *M. sibogae* from the Malay Archipelago; Schultze's *M. siderea* of the east African coast, and Kishinouye's *M. physophora* found off the coasts of Shima and Sagami, Japan, during summer. It was first taken on the coasts of New Guinea (Lesson) while the most recent record, from Banka Straits, by the "Alva" refers to the typical *papua* and not the variety *sibogae*.

MATERIAL EXAMINED: Twenty-six jellies, from Muntok, Banka Island, Banka Straits, Dutch East Indies, October, 1931; labeled taken with large sea-jelly, *Versura palmata* Haeckel.

COLOUR: This jelly-fish is variable in colour, the bell and mouth organs normally being greenish-blue or olive-green to olive-brown, the exumbrella having, especially near the margin, numerous oval markings of white, yellow, brown, blue or green. The frills of the mouths vary from olive, greenish-blue, yellowish-green to brown, usually in tones harmonious with the remainder of the organism.

TECHNICAL DESCRIPTION: The bell is from 25 to 60 millimeters diameter in the present series consisting of twenty-six specimens. Specimens measuring 80 millimeters diameter have been recorded by Mayer.

The bell is hemispherical, in preserved specimens varying from slightly less or slightly greater fullness than a hemisphere, of firm, gelatinous substance, the exumbrella showing fine granulations. There are eight rhopalia, each possessing a pigmented mass of concretions and a shallow, exumbrella, sensory pit devoid of furrows. There are eighty marginal lappets. Each octant has two small, pointed ocular lappets and eight larger, distally rounded velar lappets, with deep grooves between them extending up the sides of the umbrella for a distance about equal to two and a half or three times the width of a velar lappet. The arm disk is a little more than half the width of the bell. The four subgenital

ostia are each about twice as wide as the columns between and are constricted medially. The subgenital porticus is unitary.

There are eight mouth-arms, each of which is about as long in the dead specimen as the bell radius. The simple upper part is about 0.4 as long as the frilled distal portion which is three-winged. The frilled mouths are numerous along the margins of the three wings and also for considerable distance inward along the sides of each wing. Numerous small, club-shaped vesicles arise between the mouths on the outer sides of the mouth arms; a few long filaments similarly arise on the ventral or inner sides of the mouth-arms. The distal end of each mouth-arm terminates in a clavate tentacle or filament, which varies in length from zero to approximately equal to the bell diameter. This club is subtriangular in cross-section and contains an axial canal. Each mouth-arm contains a main canal that arises from the stomach and within the arm dividends into three branches which extend to the three series of frilled mouths of the winged lower part of the arm with ramifications and distally these three unite in confluence with the axial canal of the distal club.

The central stomach is cruciform and gives rise to the eight radial canals which extend to the rhopalia. These radial canals are communicant by means of the wide ring canal which is situated well inward from the margin. Each octant of the stomach between the rhopalar canals gives rise to six to nine anastomosing radial canals that fuse with the ring canal. The ring canal gives rise on the outer side to a fine mesh network of anastomosing vessels that extend into the marginal lappets and unite with the ends of the rhopalar canals. The circular muscle area of the marginal zone of the exumbrella is very much interrupted in the eight rhopalar radii. The gonads consist of four folded walls forming cruciform sides of the subgenital aperture.

This species is a rapid swimmer, moving by an incessant rhythmic pulsation of the bell rim which alternately contracts and expands.

The young stage of this species was described by Agassiz and Mayer (1899).

REFERENCES: *Cephea papua*, LESSON, R. P., in DuPerry, L. I., Voy. Autour du Monde, La Coquille, 1822-25, Zool., t. II, pt. II, 1829, p. 122, pl. 11, figs. 2, 3.

- Cephea papuensis*, GRIFFITH, E., in Cuvier's Regne Anim. 1832, pl. 3, fig. 3.
- Pseudorhiza thocambau*, AGASSIZ, A., and MAYER, A. G., Bull. Mus. Comp. Zool., 1899, vol. XXXII, p. 173, pl. 13, figs. 40-44 (young stages).
- Mastygias papua*, VANHOFFEN, E., Wiss. Ergeb. deutsch. Tiefsee Exped. Valdivia, 1902, Bd. 3, lief. 1, p. 47, tab. 1, figs. 17-19.
- Mastigias physophora*, KISHINOUE, K., Zoolog. Mag. Tokio, 1895, vol. VII, No. 78, 3 pp., pl. 13, figs. 1-13.—SCHULTZE, L. S., Denkschr. Med. Nat. Gessell. Jena, 1898, Bd. VIII, p. 443.—VANHOFFEN, E., *op. cit.*, "Valdivia" p. 49.
- Mastigias papau* variety *physophora*, MAAS, O., Abh. Akad. Wiss. Munchen Suppl. N. Bd. I, Abh. 8, p. 46.
- Mastigias papua*, AGASSIZ, L., and MAYER, A. G., Contrib. Nat. Hist. U. S. (Smiths. Publ.), 1862, vol. IV, p. 152.—HAECKEL, E., 1880, Syst. der Medusen, 1879, Bd. I, Densch. Med.-Naturwiss. Gessellsch. zu Jena, p. 623.—MAAS, O., 1903, Scyphomedusen der Siboga Exped. Monogr. Number XI, p. 66, 69, taf. 12, fig. 111, MAYER, A. G., Medusae of the World, Carnegie Inst. Wash. Publ. 109, 1910, pt. III, p. 678, fig. 415.—LIGHT, S. F., 1914, Philippine Journ. Sci. Sect. D., Biol., vol. IX, p. 209.—MAYER, A. G., Bull. 100, U. S. Nat. Mus., vol. I, 1917, p. 220.

Genus: VERSURA Haeckel

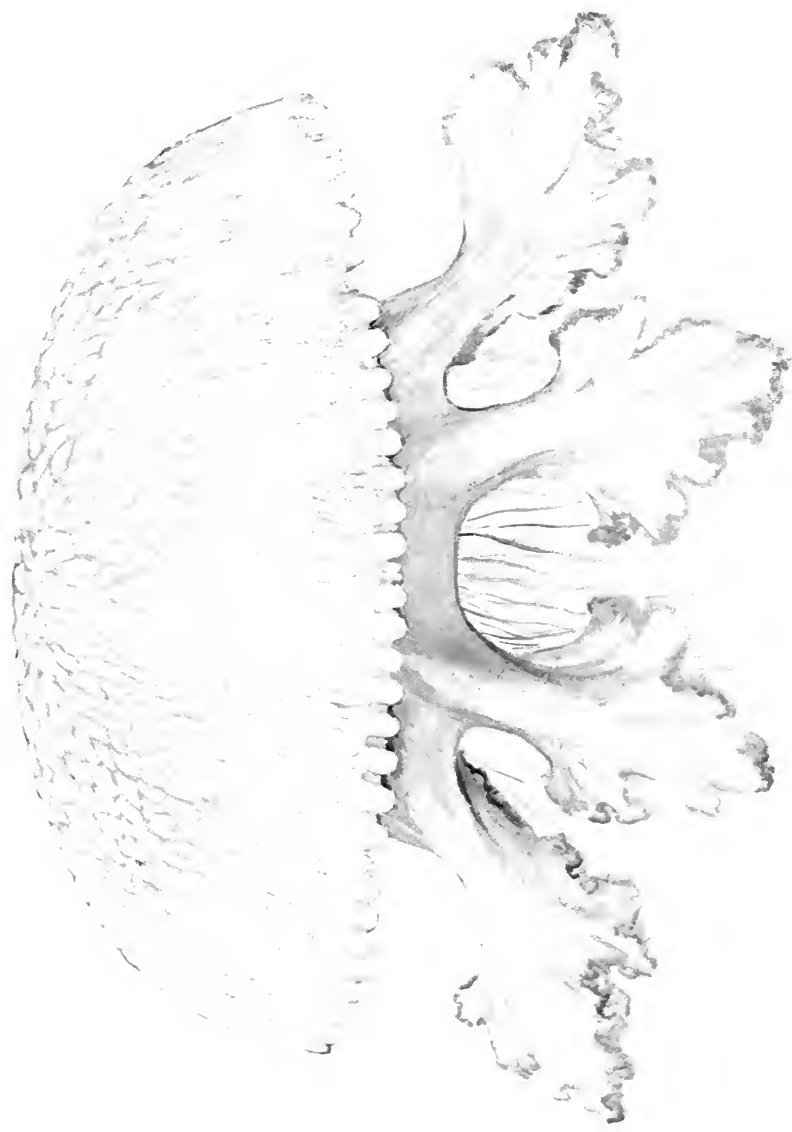
Versura palmata Haeckel

1

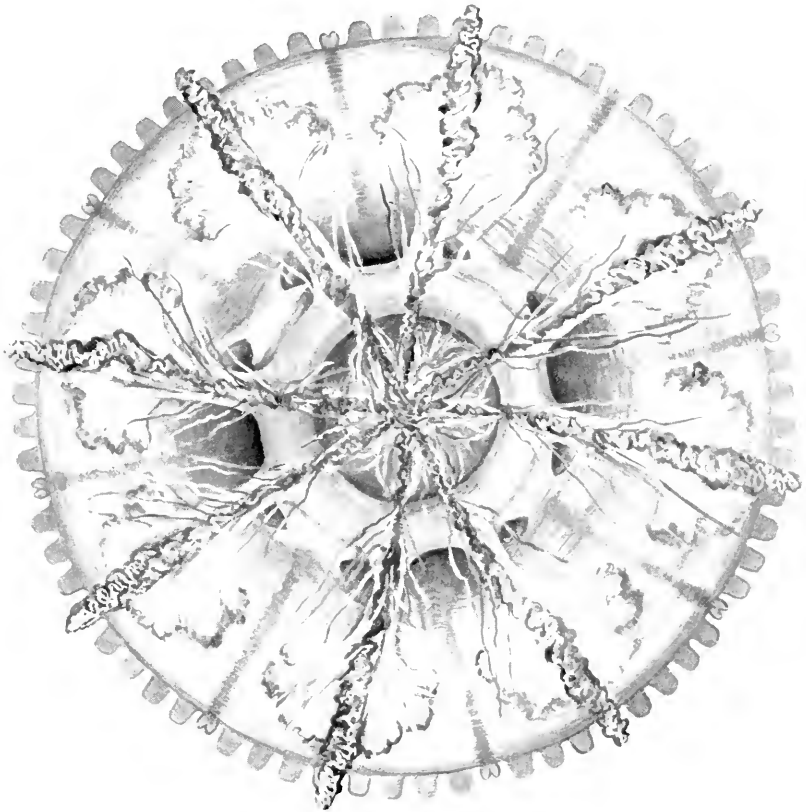
Plates 8 and 9

TYPE: Haeckel's description is based on specimens from the Malay Archipelago, Sunda Sea, Java, Cherebon, Andrea. The depository is not directly stated, but much of Haeckel's collection was deposited in the Jena University Museum.

DISTRIBUTION: In addition to the localities cited above Goette recorded specimens from Zanzibar, Singapore and northward at



Versara palmata Haeckel, profile of largest specimen taken in Banka Straits,
Dutch East Indies, by the "Alva," $\times 0.12$



Versura palmata Haeckel: ventral view of largest specimen taken by the "Alva," in Banka Straits, .1 of natural size.

Nagasaki, Japan. Vanhoffen reported it from the Sulu Seas and Java.

MATERIAL EXAMINED: One specimen from Banka Straits, diameter about 8 inches. Two specimens from Muntok, Banka Island, the complete one having a diameter of 18 inches, while the much larger, imperfect specimen indicates a diameter of about 22.5 inches.

TECHNICAL DESCRIPTION: The "Alva" specimens are much the largest recorded to date of this magnificent species of the *Rhizostomata triptera*, which are distinguished from the six other groups of *Rhizostomae* by having each mouth-arm three-winged, possessing a ventral and two dorsal branches which meet at the lower or free end of the arm.

Haeckel's type measured 60 millimeters width diameter and 20 millimeters thick. Goette's specimens varied from 5 to 65 millimeters wide.

The entire Muntok specimen has the bell wide, circular, less elevated than a hemisphere, 200 millimeters diameter, about 50 millimeters thick near the center, about 30 millimeters thick midway the radius and about 5 millimeters thick near the circumference.

The bell is about 200 millimeters wide diameter, less elevated than a hemisphere and but little convex. The exumbrella is covered with a network of anastomosing reticulations defining irregular polygonal elevations. This network is coarser at the center and finer meshed toward the circumference. It is probable that in the present specimens these are accentuated by death. The gelatinous substance of the bell is semi-opaque, about 40 to 50 millimeters thick near the center, about 30 millimeters midway and about 5 millimeters thick near the margin. It has a brownish-yellowish tinge which may be due to the presence of algae. There are eight rhopalia set within very shallow niches in the bell margin. The velar lappets said to vary from four-double to twelve per octant are eight in the present specimen, each being shaped as shown in plate and separated by short, narrow clefts. The arm-disk is nearly two-thirds as wide as the bell radius. The four subgenital ostia are about twice as wide as the perradial columns between them. The subgenital cavity is narrow, cruciform, unitary. The eight mouth-arms are each about equal in

length to the radius of the disk and extend almost to the circumferential margin when laid out flat. The upper simple axial shaft of the proximal part of each arm is about two-fifths of the total length, while the three-winged distal part is three-fifths of this length, Y-shaped in cross-section and almost as wide as long. The free margins of this Y are multiple-branched and folded and bear the frilled mouths. Each lamella of the mouth-arm has seven or eight deep clefts. There are many small club-shaped vesicles scattered among the frilled mouths and several larger terminal clubs along the lower or outer end of each arm. Numerous strong, tapering filaments occur between the mouths along the side of the arm. The rows of frilled mouths along the axial side of the arms extend to the center and here form a rosette-like arrangement. There are present a great many long, tapering, thread-like filaments that arise independently and hang down. The central stomach is cruciform, the arms being perradial. Four perradial canals extend direct from the four angles of the central stomach to the four perradial sense-organs respectively. From each of the four interrarial sides of the stomach there arises a network area of anastomosing capillary-like vessels, from each area of which arises an interrarial canal that extends to the four perradial sense organs. Some few branches from the anastomosing interrarial area extend out and unite with the perradial canals. All eight radial canals are intercommunicant through another zone of anastomosing vessels near the margin, some of which vessels extend into the lappets, this marginal network fulfilling the function usually performed by a *true ring canal*, which is absent in members of this genus. There is also a main canal arising from each of the four perradial corners of the central stomach which goes down into the arms, where it branches complexly, these branches going into the mouth-arms.

The umbrella is strengthened by a wide area of concentric ring muscles, the outer portion of which extends close to the marginal lappets; the ring is divided into eight sectors by as many radial-canals. On either side of each radial-canal and parallel thereto are narrow areas of fine radial muscles, supporting the umbrella and in a measure protecting the canals.

REFERENCES: *Versura palmata*, HAECKEL, E., Syst. der Medusen, 1879, Bd. I, Densch. Med.-Naturwiss-Gessellsch. zu Jena,

1879, Bd. I, p. 606, taf. 40, figs. 9-12.—GOETTE, A., Sitzungsb. K. Preuss. Akad. Wiss. Berlin-Jahrg., 1886, halband II, (Berlin Mus.).—HAMANN, O., Jena, Zeitsch. Naturwiss. Med.-Naturwiss. Gesell. Jena, 1882, Bd. XV, n. f. 8, p. 253.—VAN-HOFFEN, E., in Leuckart, C. G. u. Chun, C., Biblioth. Zool. Abh. gesamtgebiete der Zool., 1889, Aft. III, Unt. semastome u rhizostome Medusen, p. 42.—MAYER, A. G., *Medusae of World*, Publ. Carnegie Inst. Wash., 1910, vol. III, p. 685.

Genus: *STOMOLOPHUS* L. Agassiz

Stomolophus meleagris L. Agassiz

1

See Plate 10, Volume IV

MATERIAL EXAMINED: One large specimen, taken in Conway Bay, Galapagos Archipelago, July 28, 1931, by the "Alva."

REMARKS: This specimen, an unusually fine one, the bell (preserved specimen) having a maximum horizontal diameter of 280 millimeters and a vertical diameter of 120 millimeters, the length of the manubrium being 140 millimeters, is of exceptional interest since it is the first record of the adult species from the Galapagos Archipelago, from which locality Haeckel described the younger stage of the species as *Brachiolophus collaris* Haeckel (1880), the few other West Coast of America records being restricted to the mainland, ranging from San Diego, California, (Bigelow, 1914), where Dr. Henry B. Bigelow recorded the Prussian blue colour variety of *Stomolophus meleagris* as abundant during August and September, 1913, and the Pacific Coast of Costa Rica from which Haeckel (1880) described it as *S. agaricus* and the Bay of Panama specimens described as *S. chuni* Vanhoffen (1910).

This species is much better known from the many records on the East Coast of the United States, from inside the Chesapeake Bay, off Tangier Island and southward to the Capes (Boone) and more especially from the Atlantic Coast off the Virginia Capes, on the coast of North Carolina, down to South Carolina (type locality), also at Charleston (Mayer), the beach of Warsaw Island,

below Savannah, Georgia (L. Agassiz, type series), Miami Beach, Florida, (Boone, 1923, also 1933), Tortugas, Florida and Cuba (Mayer), at Surinam, described as *S. fritillaria* (Haeckel, 1880), also the northern shores of South America and in the Gulf of Paria, between Trinidad and Venezuela (Trinci, 1906, described as *S. chuni*).

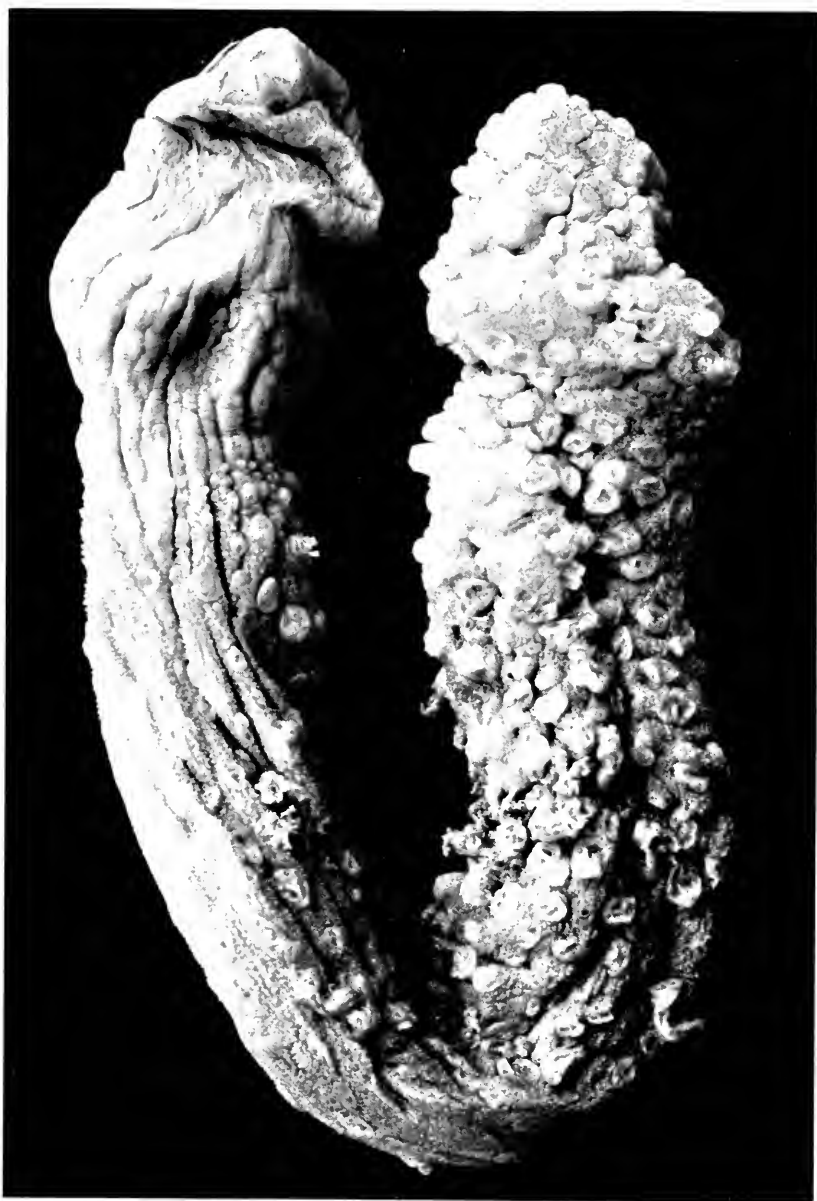
Full description and discussion of the Miami Beach, Florida, specimens, collected by Mr. Vanderbilt, in his yacht "Ara," is presented in Volume IV, Bulletin of the Vanderbilt Marine Museum, p. 48, plate 10.

The present Galapagan specimen conforms in all anatomic details with the Atlantic specimens, except that it exceeds these in the number of marginal lappets, which average twenty to twenty-two per octant in this unusually large example of the species. However, as Dr. Bigelow has illustrated with Atlantic and California Pacific specimens, there is no correlation between the number of lappets and geographic occurrence. The number of lappets in the present Galapagan adult specimen is no greater than are already known from specimens from both coasts.

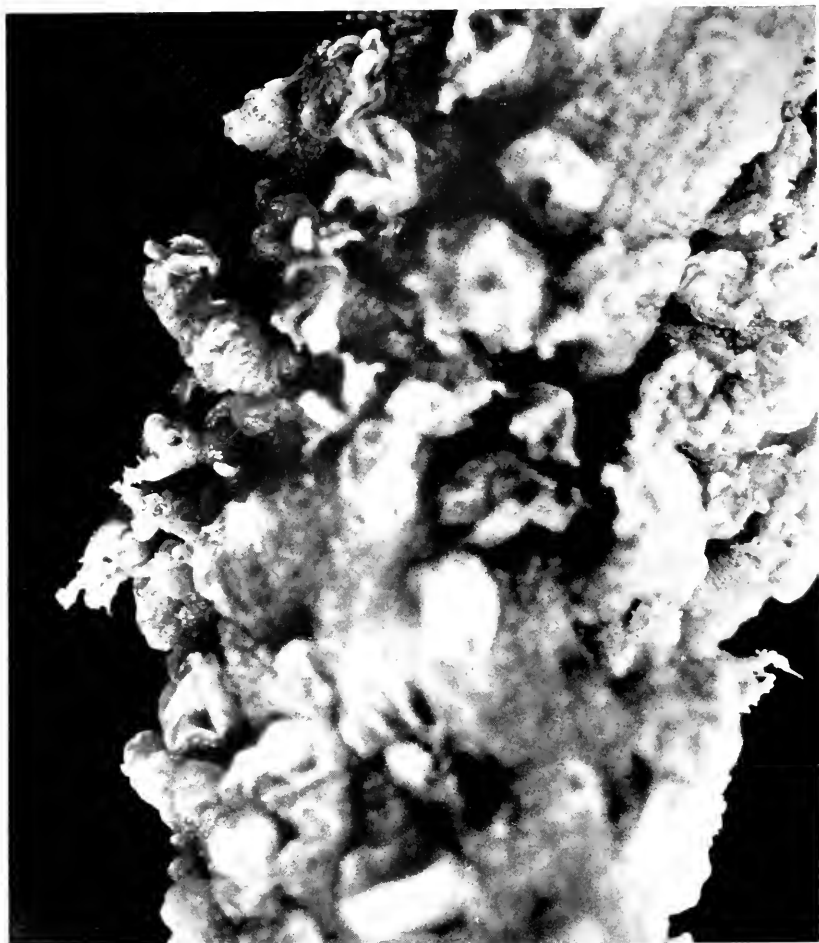
REFERENCES: *Stomolophus meleagris*, HAECKEL, E., System der Medusen. Zweite Hafte des System der Medusen. Jena Denkschr. I, 1880, p. 599; *S. fritillaria*, HAECKEL, op. cit., p. 598; *S. agaricus*, HAECKEL, E., op. cit., p. 598; as *Brachiolophus collaris*, HAECKEL, E., p. 597.

Stomolophus chuni, VANHOFFEN, E., Ueber semaeostome und rhizostome Medusen. Bibl. Zool. I, 1888, I, heft. 3, p. 43.—TRINCI, G., Ann. Museo R. Univ. Napoli, 1906, ser. 2, t. IX, p. 1-4.

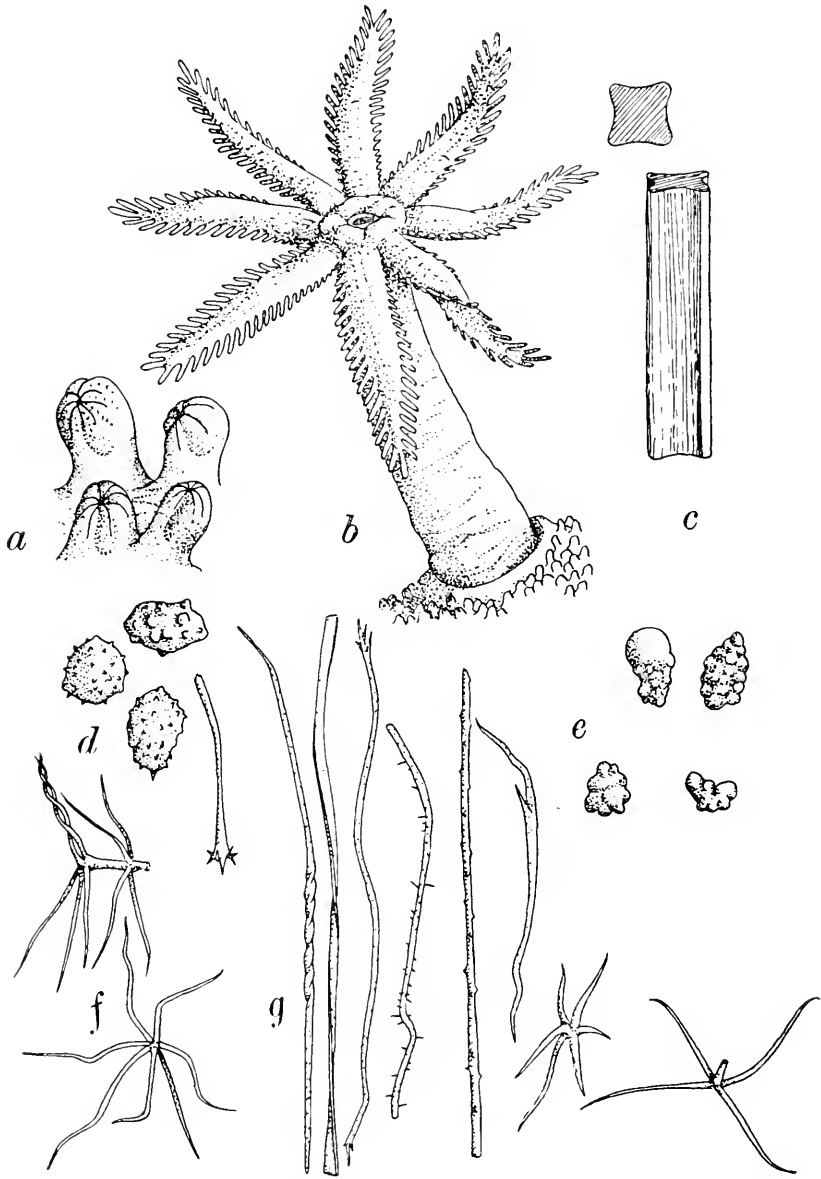
Stomolophus meleagris, BIGELOW, H. B., Univ. of Calif., Publ. Zool., 1914, vol. XIII, No. 10, p. 239.—BOONE, L., Bull. Vanderbilt Mar. Mus. 1933, vol. IV, p. 48, pl. 10 (with early synonymy).



Veretillum vanderbilti Boone, type colony, about natural size.



Veretillum vanderbilti Boone, type, photograph of a one-inch transverse section, selected about midway the length of trunk, showing the relative occurrence of autozooids and siphonozooids, greatly enlarged.



Veretillum vanderbilti Boone, type: a, group of siphonozooids, $\times 20$; b, an expanded autozooid, $\times 20$; c, transverse and longitudinal sections of axis, $\times 4$; d, spicules, sphaeroidal and ovoidal bodies from cortex of anthocodia, $\times 50$; e, spicules from cortex of rachis, irregular, rosette disks with nodular excrescences; f, single and double stellate spicules from cortex of anthocodia, $\times 50$; g, needle-like spicules from the cortex of anthocodia and cortex of rachis also stellate spicules from rachis, all $\times 50$.

Order: PENNATULACEA

Family: VERETILLIDAE

Genus: VERETILLUM Cuvier

Veretillum vanderbilti, new species

1

Plates 10, 11 and 12

TYPE: One colony, in excellent state of preservation, taken in 25 fathoms, seven miles northeast of Corregidor Island, Manila Bay, Luzon, Philippine Islands, January 25, 1929, by the "Ara."

The present species, seventh member of the genus *Veretillum* Cuvier, as given by Hickson (1916),¹ and augmented by a sixth species from the Gulf of California (Deichmann, 1936),² is the second member of the genus possessing spicules in the anthocodia, the other one being the genotype, *V. cynomorium* (Pallas)³ which is known from the Red Sea, Mediterranean Sea and North Atlantic to the Bay of Biscay and on the west African coast to South Africa. *Veretillum vanderbilti* differs from *V. manillense* Kolliker⁴, the only other species described from the Philippines, in the presence of abundant and distinctive spicules in the cortex of the rachis of *V. vanderbilti*.

The present writer keenly appreciates the fact, pointed out by Mr. Hickson, that there is really little difference of importance existent between the Indo-Pacific species, *Veretillum manillense*, Kolliker, *V. tenue* Marshall and Fowler and *V. malayense* Hickson and the present species and that it is probable that all these Indo-Pacific species of the genus will be united, but since this cannot be sensibly done without study of a comprehensive series of specimens, it provisionally seems necessary to keep the "Ara" specimen separate as a new species, particularly since it is the only Indo-Pacific series possessing distinctive spicules in the anthocodia and also has numerous spicules intermeshed or interwoven in the mesoglea of the rachis.

¹*Veretillum*, HICKSON, S. J., Siboga-Expeditie, Pennatulacea, Monogr. XIV, 1916, pp. 46-50.

²*Veretillum binghami*, DEICHMANN, E., Bull. Bingham Oceanogr. Found., Yale Univ., 1936, vol. V, p. 4, text fig. 1.

³*Pennatulium cynomorium*, PALLAS, P. S., Misc. Zool., 1766, p. 176, pl. 13, figs. 1-4; with earlier records in Rondelet, 1554, etc.

⁴*Veretillum manillense*, KOLLIKER, A., Senckenb. Naturf. Gessellsch., abh., 1872, Bd. VIII, p. 142, fig. 189.

The species is placed provisionally in the genus *Veretillum*, Cuvier (1798), although the writer is quite aware that the present species, *V. vanderbilti*, possesses in addition to the "thin plate spicules" accepted as typical of the genus *Veretillum*, the smooth needle-shaped spicules, sometimes branching at the extremities, considered distinctive of the genus *Cavernularia* Valenciennes, Milne Edwards et Haime (1857), and likewise possesses "rod-shaped" or "flattened needle-shaped ridged spicules" diagnostic of *Actinoptilum* Kukenthal (1910), while the denticulate spheroidal or ovoidal spicules of the cutis of the rachis of *V. vanderbilti* are but a slightly more primitive form of the "double club" or dumb-bell" shaped thorny spicules typical of the genus *Liturgia* Valenciennes (1850).

The alternative of designating a new genus within the group seems most undesirable, in view of the existent variability of characters accepted for those genera comprising the *Veretillidae*.

COLOUR: Mr. Vanderbilt's colour notes state: "Colour of naked part orange-yellow, body pink-salmon, tubes of polyp transparent, tentacles yellow."

TECHNICAL DESCRIPTION: The single well preserved colony gives the following measurements, all expressed in millimeters: Total length 300, length of stalk 50, maximum diameter of bulb 35, length of trunk 250, average diameter of trunk 30.

The colony is cylindrical, the proximal sixth forming a spongy stalk, distinctly bulbous, the trunk being rather evenly dilated, moderately tapered on the distad fifth, the apex rounded and crowned with numerous large autozooids; the coenchyma is firm, compact. The autozooids are large, distributed over practically the entire surface of the trunk, with the numerous siphonozooids crowded in the interstices. The autozooids occur in practically all stages of expansion and retraction, being capable of complete retraction within the cuplike base; a typical average large autozoid expanded is shown in plate 12, figure b.

The expanded portion of an autozoid has an average anthocodia length (in millimeters) of 14, disk diameter of 5, tentacle length 5 (measured additional to the length of the anthocodia), basal pinna 0.8 and distal pinna 1 to 1.2 long. There are eight large, pinnate tentacles each side of a central tentacle, the cavity of the tentacle extending within the pinnae, which normally increases

in length gradually through the series from proximal to distal, the most proximal pinnae being from 0.5 to 0.6 the length of the most distal pinnae. The stomodaeum extends nearly the entire length of the anthocodia.

The siphonozooids show an eight-rayed aperture, but no trace of tentacles. The siphonozooids are numerous, closely set and apparently irregularly arranged over the entire surface of the trunk between the autozooids. The average vertical diameter of a siphonozooid is 3 millimeters.

There are two kinds of spicules that occur abundantly in the cortex of the anthocodia, namely, sphaeroidal to ovoidal small bodies with the external surfaces covered with fine sharp asperities and somewhat larger ovoidal bodies in which the asperities are replaced by larger, convex nodes. There are also five types of long, narrow spicules that occur in the polyp in moderate quantities: (a) needle-like spicules, three to four times as long as a sphaeroid, slightly bowed, with one end rounded, the opposite end slightly dilated and furnished with numerous outjutting spines; (b) very long spicules, 2.8 to 3 times the length of the preceding needle-spicules, with the median third twisted and contour somewhat irregularly flexed; (c) similar long needles, but with only three or four twists widely spaced in the entire spicule; (d) similar long slender needles of sinuate contour with both ends terminating in a cluster of four to six outjutting spines; (e) needle spines of sinuate contour with both lateral margins beset with numerous thorn-like barbules. A third type of spicule found in the anthocodia is the star-shaped type, shown in figure f, a six-rayed star with unequal rays variously bent or curved, with a supporting rod or shaft, a seventh ray, extending at right angles from the center of the star; there are also double stars, as shown in figure f, arising from the same supporting rod.

The spicules of the cortex of the stalk are scarce, of three types: (a) subspherical to irregularly nodular small bodies externally covered with convex nodes; (b) long, nearly straight needle-like spicules with numerous barbules on the lateral surface, also there are sinuate needle-like spines (figure g); there are also four to six-rayed star-shaped spicules present.

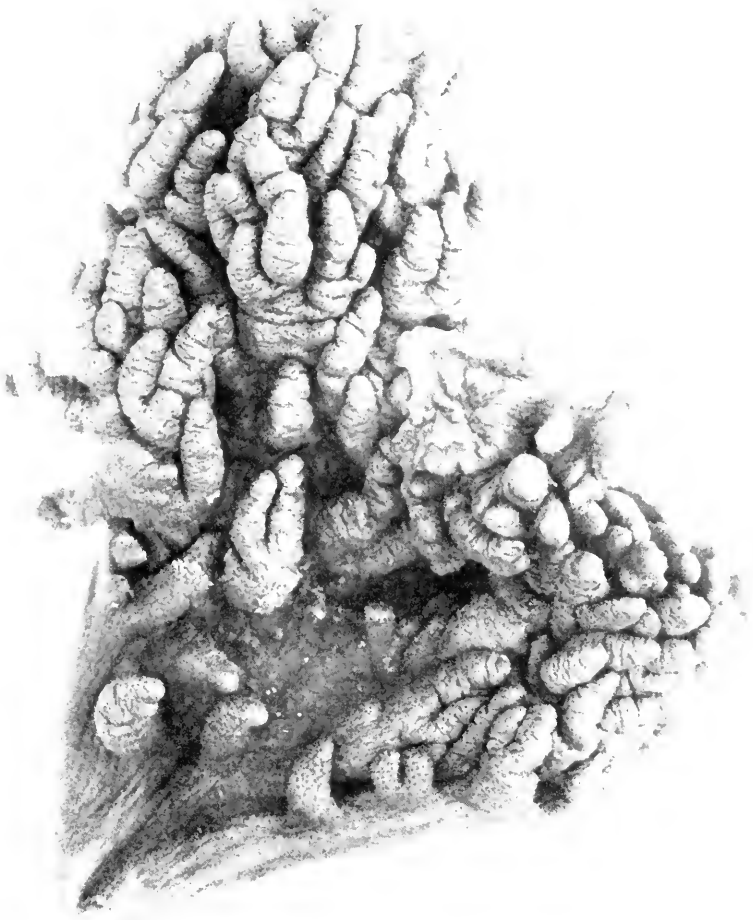
The spicules of the cortex of the rachis are abundant, in the form of irregular shaped disks or scales, somewhat rosette-shaped,

ornamented with numerous convex nodes and less frequently with perforations of small, irregularly oval or elongate design in the surface interstices, among the convex nodes. A thin, transparent variety of this scale is shown in figure e. These latter scales are less abundant, but are larger than the above described rosettes. The sphaeroidal bodies are moderately abundant, less frequently ovoidal, in each instance with the external surface continuously beset with asperities.

Two types of long needle-like spicules are moderately abundant in the cortex of the rachis: three varieties of long, bowed needles, one smooth, distally tapered, in both directions; a second variety bowed and distally terminating at each end in a cluster of eight to ten bristly spines; a third kind, bowed, shorter than the preceding variety, wider in ratio to length, with the two flat lateral surfaces distinctly transversely striate, like a file. There are also needle spicules with one end distinctly flexed into a wide curve, the more elongate of such spicules being tapered at both ends; the shorter forms being thicker with the distal ends dilate and spinose. A rather rare type of spicule is the spiral, variously of a one and a half to two or more whorls, with both distal ends terminating in a cluster of long divergent spines. Single and double star-shaped spicules are also present in varying growth stages.

The axis is a deep ivory color, four-sided in transverse section, nearly square, with the angles blunt and the sides moderately concave. (Plate 12, figure c.) It tapers proximally, beginning near the base of the bulbous stalk and continues in the rachis where it is thick for the proximal half, 2.5 millimeters wide, more slender distad, the tip of the axis extending quite to the apex of the trunk.

It is a pleasure to dedicate this species to the collector and Commandant of the "Ara" World Cruise, Mr. William K. Vanderbilt.



Lobularia ceylonicum (Pratt), colony from Raiatea Island, Society Islands,
about natural size.

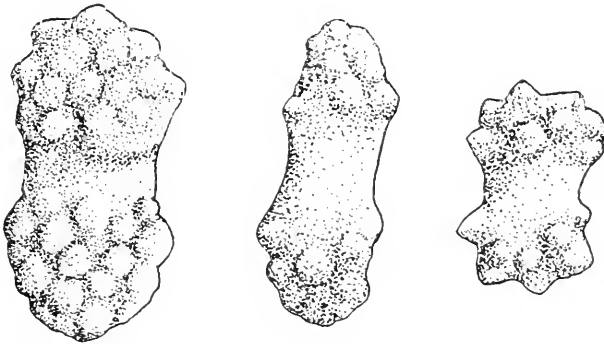
Order: **ALCYONACEA**
 Family: **ALCYONIIDAE**
 Genus: **LOBULARIA** Savigny
Lobularia ceylonicum (Pratt)

Plate 13

TYPE: Miss Pratt's type was taken at Galle, Ceylon. The type depository is not stated, but is probably the government museum at Colombo, Ceylon, and the Liverpool University museum.

DISTRIBUTION: Ceylon (Pratt); "Siboga" station 273, Jedan Island, Dutch East Indies; Society Islands (Boone). Littoral zone.

MATERIAL EXAMINED: Three separate colonies, Teviatea Reef, Raiatea Island, Society Islands, August 21, 1931.



Text figure 2.—*Lobularia ceylonicum* (Pratt), spicules: left, example from stalk, median and right two types predominant in the lobes, all greatly enlarged.

TECHNICAL DESCRIPTION: The colony (dead and shrunken) is low-growing with a length of 12 centimeters, a width of 6 centimeters and a total height of 6 to 8 centimeters. The capitulum is low and bears numerous irregularly shaped lobes, some of which are subcylindrical, distally convex and others are irregularly shaped low, convex lobes, rather closely crowded together. The average size lobe has an apical short diameter of 3 millimeters, long diameter of 5 millimeters. The smaller subcircular lobes are 2 to 3 millimeters diameter and 5 to 9 millimeters high. The

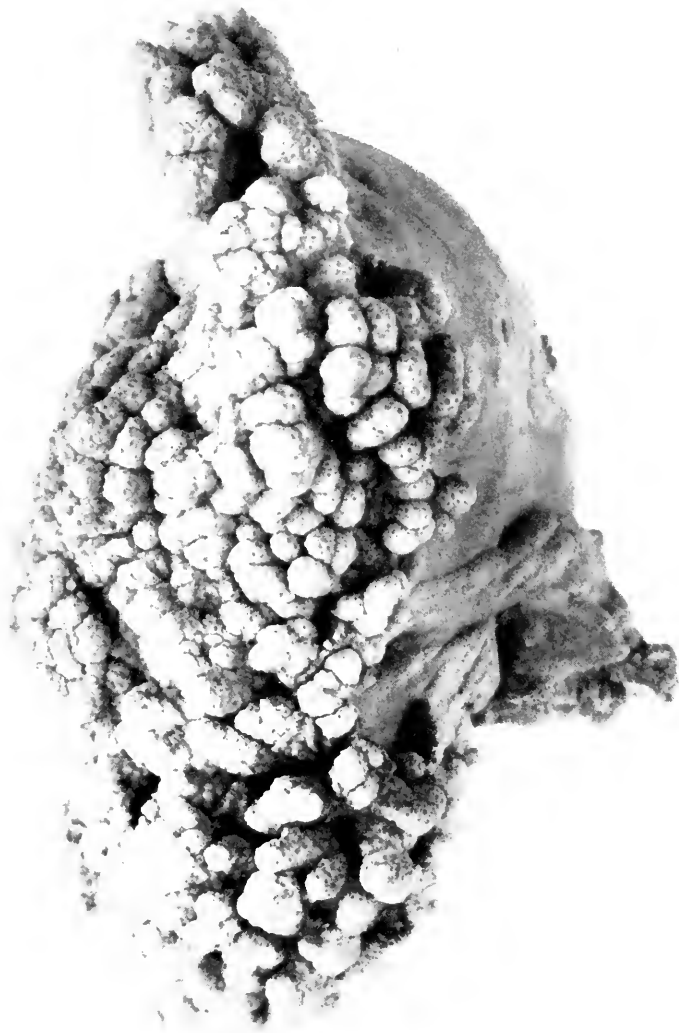
polyps are numerous, five or six in a line of five millimeters. The polyps are large, well defined, nearly circular, with the summit divided by eight convergent segments, the center somewhat drawn and concave.

The sterile stalk is 3 to 4 millimeters high, tough, coriaceous and has a pronounced calcareous texture before branching. It divides into five or six branches which are short, closely appressed, which in series each divide to serve as bases of about three lobes, less frequently into four to six lobes. The external surface of the sterile stalk bears a conspicuous layer composed of coarse dumb-bell shape spicules (as in fig. 2). These spicules, while similar to those of the lobes in contour, are shorter in ratio to width, sometimes appearing as in fig. 2, or even shorter. The sub-spherical distal ends of the dumb-bells are roughened all over with coarse, irregular asperities. These spicules are closely packed together so that they form a sieve-like wall which has the depth of the length of a spicule, and consists of a pair of dumb-bells crossing another at right angles in serial repetition. An average spicule measures in millimeters: 0.5 long, 0.25 diameter of club end, 0.15 diameter of median bar.

The spicules of the lobes are of two sizes: (a) dumb-bell shapes having a length of 0.6 millimeters, width of enlarged end 0.25 millimeters and of the center bar 0.15 millimeters; (b) dumb-bell shapes in which the bell is less dilated and waist less constricted, having a length of 0.5 millimeters, width of enlarged end 0.5 millimeters and waist 1.7 millimeters wide.

REFERENCES: *Alcyonium ceylonicum*, PRATT, E. M., Marine Biol. Ceylon, Roy. Soc., London, Pt. II, 1904 (issued 1905), separate XIX, p. 257, 3 figs.

Lobularia ceylonicum, THOMSON, J. A., and DEAN, L. M. I., Siboga-Expeditie, Alcyonacea, Monogr. XIII-d, 1931, p. 39, pl. 23, fig. 2.



Aegonium confertum (Dana), colony from the Fiji Islands, the type locality, nearly natural size.

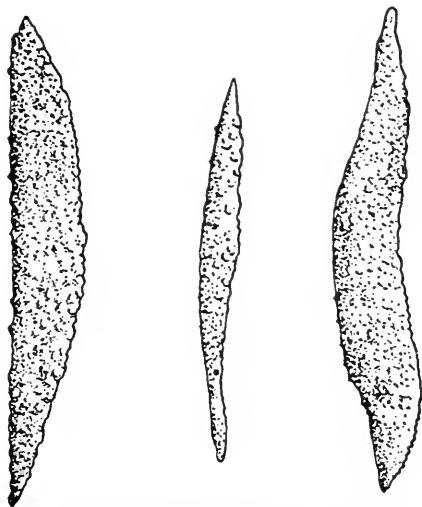
Genus: *ALCYONIUM* Linné, emended

Alcyonium confertum (Dana)

7

Plate 14

TYPE: Dana's type came from the Fiji Islands, where it was collected by the United States Exploring Expedition. It is deposited in the Philadelphia Academy of Natural Sciences.



Text figure 3.—*Alcyonium confertum* (Dana), typical spicules from cortex, greatly enlarged.

DISTRIBUTION: Fiji Archipelago (Dana; Boone).

MATERIAL EXAMINED: Three large colonies, taken by the "Alva" at Vitu Levu, Suva, Fiji Islands, September 9, 1931.

COLOUR: The colony is a dull purplish brown and the partially expanded polyps are brown.

TECHNICAL DESCRIPTION: The colony, dead and shrunken, is comparatively low-growing, with a height of 12 centimeters, length of 12 centimeters and average width of 6 centimeters. It is rather rigid, coriaceous, stipitate, the pedicel being stout and supporting numerous short, cylindrical branches, which on the average vary from 4 to 9 millimeters diameter and 8 to 22 millimeters high, being distally tapered to a blunt rounded apex. The

method of arrangement and branching is shown in pl. 14. The polyps are numerous, small, paniculate, about 1 millimeter apart, each composed of a brief pedicel, supporting 8 stout, fingerlike tentacles which are distally tapered, blunt, this distal end showing under high magnification a surface bearing numerous small asperities.

The spicules in an average small branch of the colony appear to be laid in a pattern of obliquely placed spicules with the ends fitting in the spaces between the tapered tips of the series of spicules adjacent at either end. The spicules are large, spindle shape with a slightly curved or bowed aspect and are covered with numerous coarse, conical asperities. Four variants of this spindle are to be found in quantity; (a) a straight large spindle with tapered ends, measuring 2 millimeters long and 0.5 millimeters median width; (b) a spindle similar to the above in size, but more tapered at the apices and medially constricted to narrowed neck, only 0.3 millimeters diameter, while the distal portions are 0.5 millimeters wide in a spicule 2 millimeters long; (c) a more slender spindle about 1.8 millimeters long and 0.35 millimeters wide; (d) a smaller stout spindle shape about 1.5 millimeters long and 0.4 millimeters diameter.

REFERENCES *Alcyonium confertum*, DANA, J. D., in Wilkes, Charles, U. S. Explor. Exped., vol. VII, p. 621, atlas, VII, pl. 57, fig. 7-a-b.

Genus: SARCOPHYTUM Lesson, emended

Sarcophytum reticulatum, new species

✓

Plates 15, 16 and 17

TYPE: The holotype was dredged in Pulo Condore, Anambas Islands, South China Sea, by the "Ara," February 4, 1929, and is deposited in the Vanderbilt Marine Museum.

DISTRIBUTION: Anambas Islands, South China Sea, littoral.

TECHNICAL DESCRIPTION: The colony, which in the preserved specimen is a drab light yellowish brown, the dorsum of the capitulum reticulated with white spicules forming a hexagonal, honey-

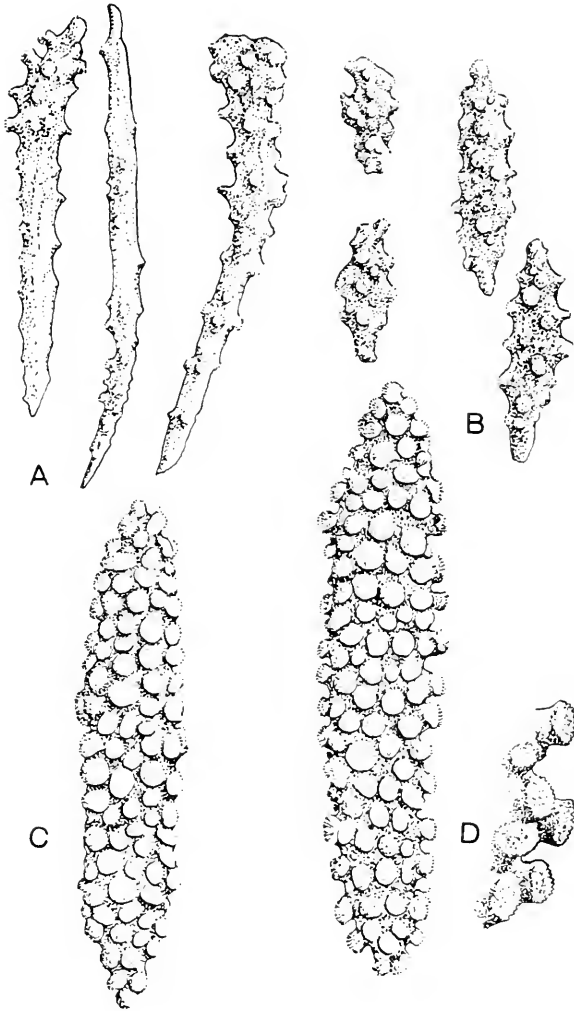


Sarcophyllum reticulatum Boone, type, dorsal view of capitulum, about natural size.





Sarcophytum reticulatum Boone, type, a small portion of dorsad of capitulum along margin, greatly enlarged, showing siphonozooids, autozooids, and reticulate pattern formed by spiculation.



Sarcophytum reticulatum Boone, type: A, spicules from the internal layer of capitulum; B, spicules from the external layer of capitulum; C, spicules from the stalk; D, detail of nodules of stalk spicules, showing granulate apices; all greatly enlarged.

comb-like pattern and with lighter creamy yellowish anthocodia; the stalk, longitudinally marked with interrupted white lines of spicules, has a large, subovate, reniform capitulum, of distinctive form, resembling in contour the Madreporariaian coral, *Fungia fragilis* Alcock. This capitulum is supported on a substantial stalk which unfortunately is torn off about three centimeters below the capitulum. The portion of stalk remaining is irregularly ovate in transverse section, very firm, coriaceous, composed of great masses of coarse spicules, which occur in nearly every position within the semigelatinous tissue, but frequently are vertical or obliquely nearly vertical, arranged in close proximity, the gelatinous tissue between the spicules seldom attains more than half of the shorter diameter of a spicule, frequently is of much less width. The circular canals perforate the stalk longitudinally numerous and are of a diameter of one millimeter and occur one to one and a half millimeters apart. The external coenchyma of the stalk is leathery with large white spicules showing through it as interrupted lines or flecks. Both the leathery external and semigelatinous internal tissues contain in addition to the spicules great quantities of minute calcareous granules of indeterminate shape.

The capitulum is soft, very flexible, with the upper surface concave in the center, the marginal border deflected and with two or three brief incisions resulting in three or four unequal, shallow lobes. The entire dorsal surface is reticulate with a very distinctive network, composed of a pavement of white spicules forming a honey-comb pattern of hexagonal units, some of which are regular, others distorted, while a few are irregular polygons. These spicule-lines border the margin of each autozoid, also the siphonozoids are located each within a unit of the reticulated pattern. The siphonozoids are small, slightly oval, with a small central aperture, from which there are eight lines indicating eight rays, divergent toward the margin.

The spicules which form the external layer of the reticulate pattern of the capitulum are shown in plate 17, fig. b. These spicules are very white, of the shapes shown, bars with very nodular surfaces, the spicules being arranged variously transversely on the surface and obliquely vertical, forming a frost-like fretwork and on the interior intermeshing with spicules of a deeper layer of the deposit, which are of the shapes shown in pl. 17, fig. c. the

predominant kind being long clubs, about 2.5 times as long as those of the external layer and distally tapered in one direction, needle-like, with the entire surface bearing numerous coarse nodules. The spicules of the external layer are shorter bars, with the surface almost entirely covered with coarse nodules.

The autozooids, which are completely retractile, within an oval aperture of a long diameter of about one millimeter, have the length, when expanded, of 11 millimeters; the polyps, when folded, forming a subspherical bud; when dilated, forming a vase-like flower, with a length of 2.6 millimeters, the tentacles being 1.5 millimeters long, digitate, with about 18 digits per tentacle, each digit a short, broad, blunt process, the cavity within it confluent with that of the central portion of the tentacle. The anthocodial armature has the formation alternate spicules. These small spicules are linear bars of smooth or finely granulose surface, not verrucose and with aborted apices.

The spicules of the stalk are shown in plate 17, fig. c. These are predominantly of the larger size, there being less than two percentum of the smaller kind. All consist of an elongate central rod, from 0.8 to 1.2 millimeters long, and 0.25 millimeters median transverse width, with the entire surface regularly covered with coarse excrescences, somewhat tree-like, consisting of a short, thick trunk supporting distally a crown, somewhat convex, of irregular marginal contour, nodular and granulose. These excrescences are placed in close formation, the usual distance separating them being usually from one-third to not quite one-half the diameter of a nodule.

This species is distinguished from all other members of the genus by its very distinctive spiculation.

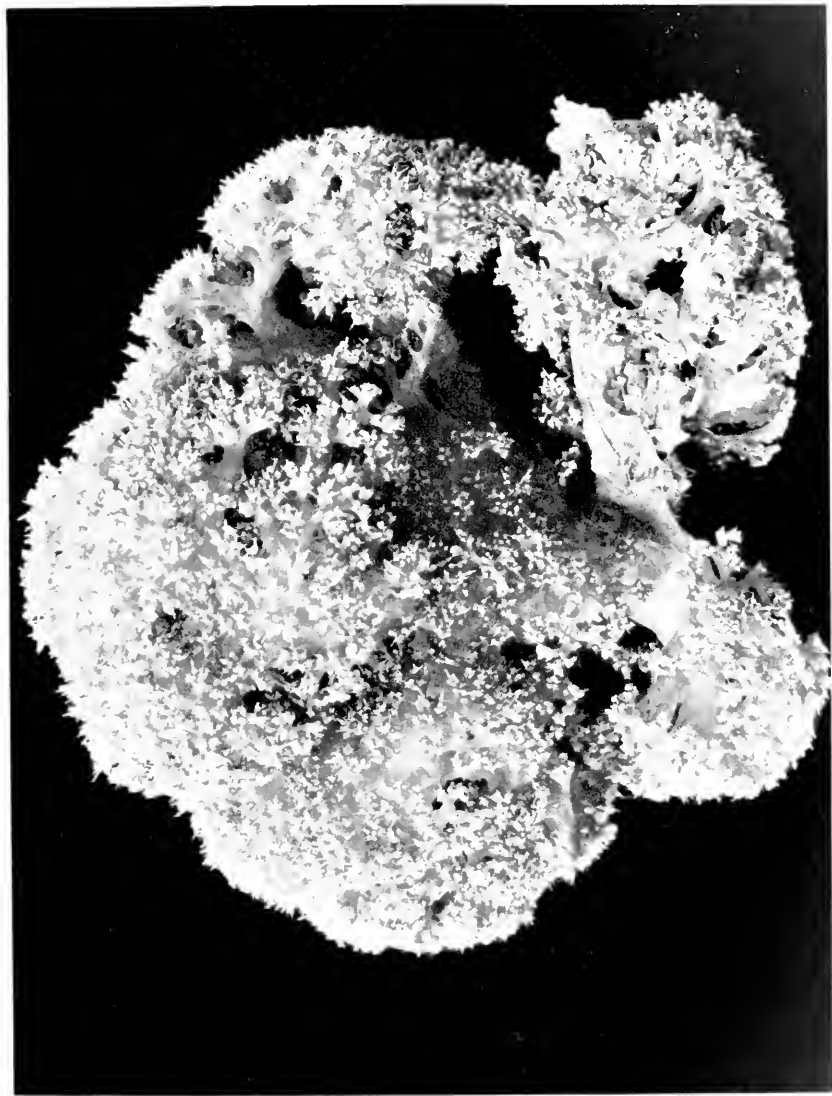
Genus: **DENDRONEPHTHYA** Kukenthal

Dendronephtya rosamondae, new species

†

Plates 18, 19 and 20

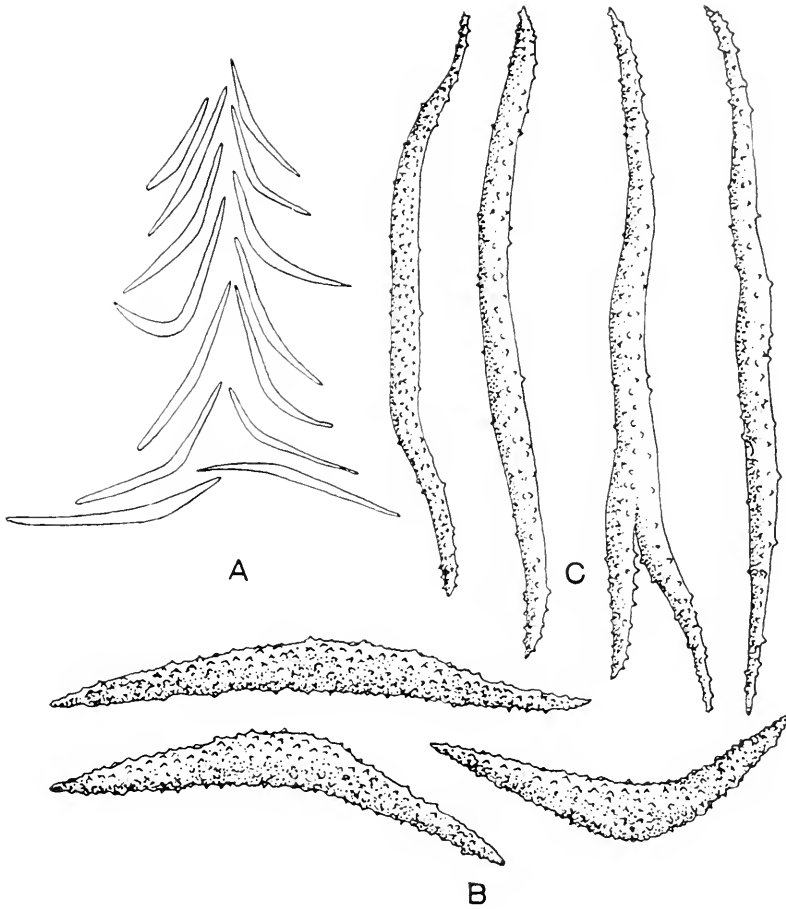
TYPE: One magnificent colony, taken at Anambas Islands, Lat. 30° N., Long. 106° E., 8 miles west of Terampa Cove, Siantan Island, South China Sea, in 33 fathoms, February 6, 1929, by the "Ara." Dedicated to Mrs. W. K. Vanderbilt.



Dendroneophtya rosamondae Boone, type, profile of colony, about 0.75 of natural size.



Dendroneurhynchia vasei Boone, type, a distal branch of the colony, showing the characteristic corymbic groups of polyps; the protruberant distal spicules, also the larger spicules of cortex may be seen, enlarged approximately twelve times.



Dendronephthya rosamondae Boone, type, A, typical anthocodial armature of spicules; B, typical spicules forming the anthocodial armature $\times 240$; C, typical kinds of spindle spicules found in the upper cortex, $\times 20$.

DISTRIBUTION: The holotype is the only record existing for this species.

COLOUR: The living colony is described in Mr. Vanderbilt's field notes as having "the stem whitish tan, the upper portions bright orange with white polyps." The abundance of pearly white encrusting spicules gives the distal portions of the colony a frosted appearance.

TECHNICAL DESCRIPTION: This colony, which reminds one of an intricate East Indian ivory carving of a miniature banyan forest, is 13 centimeters long horizontal diameter and 12 centimeters the greatest vertical diameter; umbellate, with the lower sub-branches somewhat foliaceous, with the central stem giving rise to four or five primary branches, which repeatedly subdivide, supporting the numerous characteristically corymbic groups of polyps which are usually in clusters of six to twelve. The polyp stalks are moderately long, 1.2 to 1.5 millimeters long; the supporting bundle of spicules consists of two, somewhat alternating, placed obliquely transverse. The anthocodial armature of spicules is quite regular, in four slightly alternating pairs, with two alternating obliquely transverse spicules below the chevron series. In the present species, the arrangement more nearly approaches the "Grade IV" arrangement of Thomson, Sir J. A., and Dean, Miss L. M. I., Siboga-Expeditie Alcyonacea, than any of the other groups. There are no pseudo-crown spicules present in *D. rosamondae*.

The spicules of the upper cortex are large, 4 to 7 millimeters long, elongated needle-like spindles, arranged in the oblique transverse pattern shown in plate 20. The surface of these spicules is covered with numerous, medium size, coarse, low, verrucose asperities (fig. c, pl. 20). These spicules of the upper cortex appear glassy with embedded colour streaks of pure orange and sometimes of reddish orange.

ACTINARIA

Family: CERIANTHIDAE

Genus: PEPONACTIS van Beneden

Peponactis aequatorialis (van Beneden)

1

Plate 21

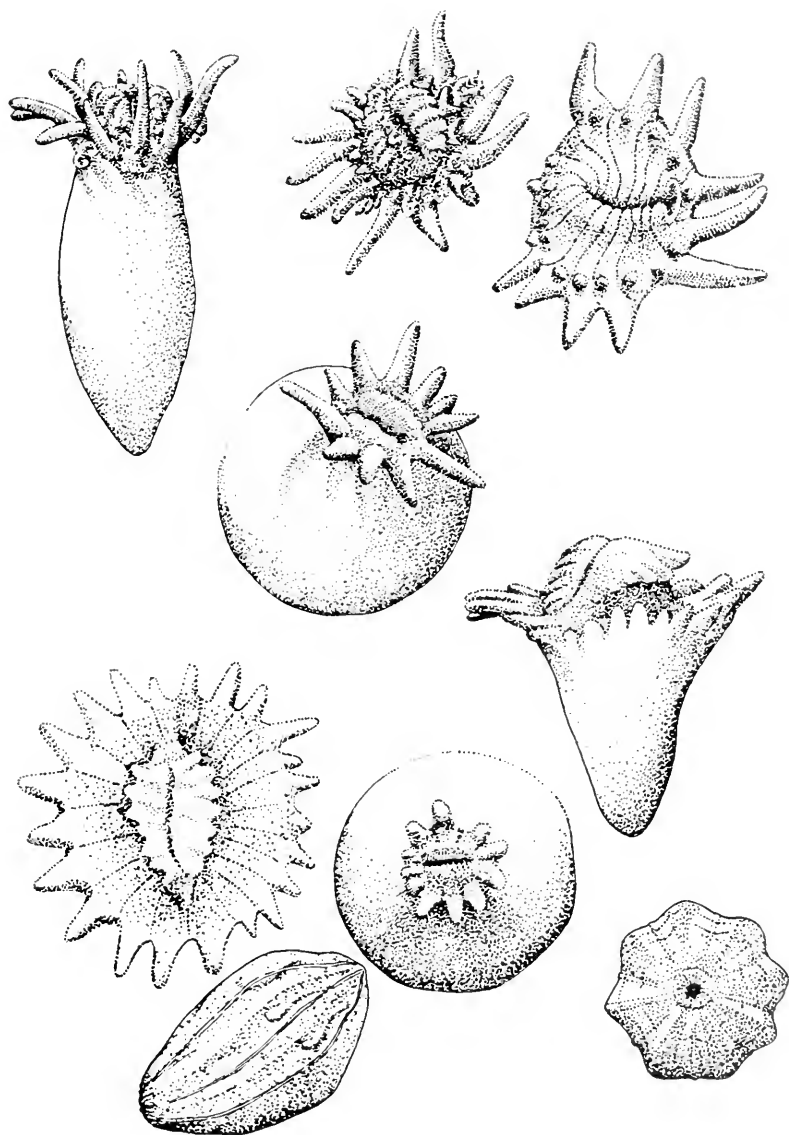
TYPE: The type of *Peponactis aequatorialis* van Beneden was taken by "der Plankton-Expedition der Humboldt-Stiftung" at Lat. N. 0.1', Long. W. 15.1°, and is deposited in the Leipzig Zoological Museum.

DISTRIBUTION: Apparently widely distributed in the equatorial Pacific, in depths ranging from the surface down to 400 meters.

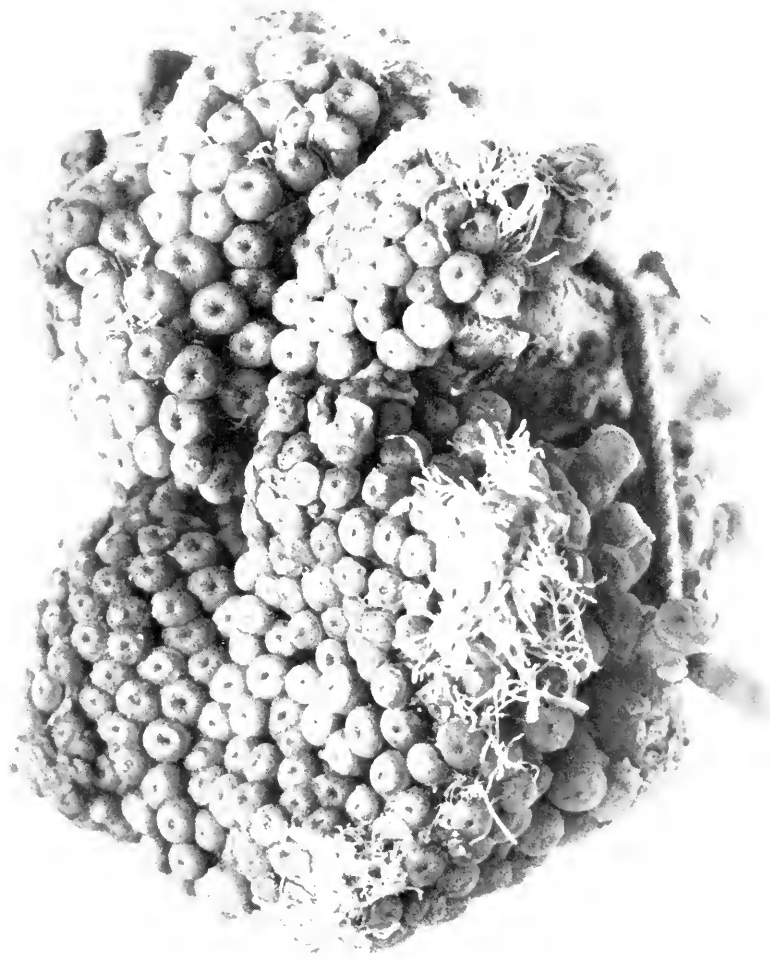
MATERIAL EXAMINED: Fifty specimens, in various degrees of development, taken a dredge haul from the surface to 140 fathoms depth, north of Nuka Hiva Island, Marquesas Islands, Pacific Ocean, August 11, 1931, by the "Alva."

DISCUSSION: A remarkably interesting series of larval *Cerianthidae*, typical forms of which are shown in plate 21, were taken by the "Alva" in a deep-sea haul north of Nuka Hiva Island. These apparently belong to *Peponactis aequatorialis* van Beneden (1898) of the typical form described by him, and also are present in considerable series possessing intermediate stages between this species and apparently younger stages of it.

The subspherical specimens have a diameter varying from 2.8 millimeters with the polar areas flattened, to 3.5 millimeters in the larger of those without tentacles; the subspherical specimens with the first, rudimentary marginal tentacles present also are of an average diameter of 3.5 to 4 millimeters, with variously ten to twelve marginal tentacles, digitiform, some short and stubby, others five to six times as long as wide. The *P. aequatorialis* typical forms vary from 4 to 6 millimeters diameter and show the tentacles in varying degrees of development, five examples of which are illustrated. The body form of these also varies from subcylindrical to obconic, but specimens of the two extremes, when dissected, fail to show any important histologic differences. The specimens are



Peponactis aequatorialis van Beneden, $\times 10$.



Gemmaria marquesana Boone, type colony, from Anaho Bay, Nuka Hiva Island, Marquesas Islands, nearly natural size.

without exception a colorless pearly translucent cream, with the mesenteries very distinctly delineated. The obconic forms have a long diameter of 7 to 8 millimeters, exclusive of tentacles.

REFERENCES: *Peponactis aequatorialis* VAN BENEDEN, E., *Ergeb. der Plankton-Expedition der Humboldt-Stiftung, Die Anthozoen*, 1897, vol. II, K.e., p. 109, pl. 9, figs. 9-16, text fig. 17.

Zoanthactinaria

Zoantheae

Family: ZOANTHIDAE Dana

Subfamily: **Brachycneminae** Haddon and Shackleton

Genus: **GEMMARIA** Duchassaing and Michelotti

Gemmaria marquesana, new species

✓

Plate 22

TYPE: Five large colonies, taken in Anaho Bay, Nuka Hiva Island, Marquesas Islands, August 10, 1931. Deposited in the Vanderbilt Marine Museum.

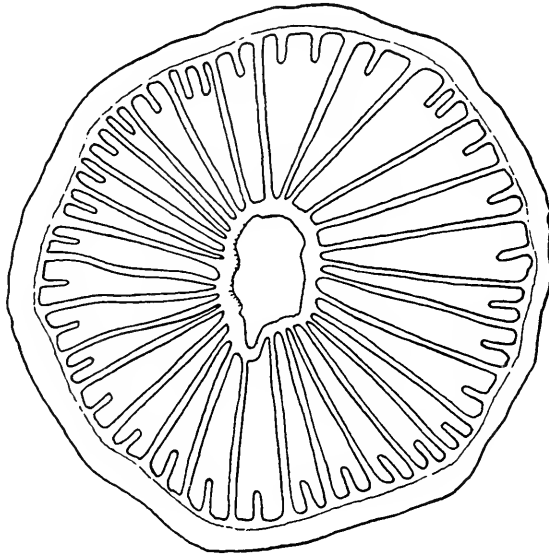
DISTRIBUTION: These rather large colonies are permanently attached to large clumps of volcanic rock, collected, apparently by breaking, in the littoral zone of Anaho Bay.

MATERIAL EXAMINED: Type series, consisting of approximately two thousand polyps.

COLOUR: Unrecorded.

TECHNICAL DESCRIPTION: The polyps are numerous, independent, attached at the base separately, closely crowded, but with a thin, basal, encrusting membrane, or with the circumferal margins of the adjacent polyps united. The polyps vary from small young ones bud-like between the side adjacent bases of large older ones, arising from the membrane encrusting coenchyme. The dead and somewhat shrunken specimens have an average size mature polyps measuring from 18 to 25 millimeters high and from 7 to 9 millimeters disk diameter. These polyps are of cylindrical form with the external surface of the sidewalls and base

thickly encrusted by small pebbles, shells, sand and similar detritus. The disk is also sand-encrusted, but in less degree. The disk is mammiform in the dead shrunken polyp, with a diameter equal to approximately one-third of the height of the polyp, and having



Text figure 4.—*Gemmaria marquesana* Boone, type, cross-section of a single polyp, greatly enlarged.

a decidedly "ribbed" appearance, having about thirty elevated radii alternating with as many radial grooves. The radii are encrusted and have a rough surface. The tentacles are in two series, about sixty-four in number, thirty-two per series. Each tentacle is wide, shortish, blunt tapered, conical, about one-third as long as the disk diameter in the dead specimen. The actinostome is slit-shaped, the actinopharynx brief, tubular, the enterostome leading into the coelenteron, which contains about sixty mesenteries of two kinds, i. e., thirty primary mesenteries alternating with thirty secondary mesenteries, which are smaller, being scarcely half so wide as the adjacent primary mesenteries. Each primary mesentery bears along the inner free edge the corkscrew-like filaments, extending about half the length of the stomach cavity below the enterostome.

BODY-WALL: The ectoderm is so thoroughly penetrated by the encrustations of sand, shell, etc., that it is difficult to determine the character of the ectodermal cells. The mesoglea adheres in coarse strands and forms a distinctive layer beneath the cuticle. The lacunae are large, irregularly oval to subcircular, their interstitial border being mesogleal threads. The body-wall appears to be pierced by longitudinal canals, from base to disk, some of which anastomose by finer canals. The endoderm lining the column forms a regular layer of large cells. The muscle tissue is well developed. The sphincter is single, well developed, mesogleal.

DISK AND TENTACLES: The ectodermal layer is well developed, but it and the mesoglea are much penetrated by the partially embedded encrustations. No zoanthellae are present but cell enclosures, similar to those described and figured by McMurrich⁵, also Haddon and Shackleton⁶, appear to be present in this new species.

AESOPHAGUS: The groove is well marked, truncated.

MESENTERIES: These are typical Brachycneminae, arranged as shown in text figure 4. The mesoglea is very well developed in both series, the muscular layer also being well developed and the mesogleal plaitings well defined. Each mesentery has a conspicuous vertical canal running through it from the base of the polyp to the disk. In the aesophagal region this canal apparently does not divide, but does become of wider diameter. The endoderm is similar to that of the body-wall. The ectoderm seems to form a regular layer. The mesenterial filaments are large, their mesoglea thin and endoderm similar to that of the mesenteries.

GONADS: Numerous mature ova are present in one of the specimens cut.

REMARKS: The present species is necessarily established, since it differs anatomically from the earlier described Australian species of *Gemmaria*, namely, *Gemmaria macmurrichi* Haddon and Shackleton⁶ and *G. mutuki* Haddon and Shackleton,⁶ both of which are from Torres Straits; *G. arenacea* Wilsmore⁷ from Masthead Island, Queensland, and from *G. Willeyi* Whitelegge,⁸ described from Funafuti, Ellice Islands.

⁵*Gemmaria rusei* McMurrich, J. P., Proc. Acad. Nat. Sci. Phila., 1889, p. 124, pl. 7, fig. 7-9.

⁶*Gemmaria macmurrichi* Haddon, A. C., and Shackleton, A. M., Trans. Roy. Dublin Soc., 1891, ser. 2, vol. IV, p. 688, pl. 61, fig. 1, pl. 63, fig. 7; Ibid, *G. Mutuki*, p. 689, pl. 61, fig. 10.

⁷*Gemmaria arenacea* Wilsmore, L. G., Journ. Linn. Soc. Zool., 1909, vol. XXI, p. 323, pls. 43, 45, figs. 16-20.

⁸*Gemmaria willeyi* Whitelegge, T., Mem. Austral. Mus. Sydney, 1896-1900, vol. III, pt. 7, 1899, p. 387, pl. 24, figs. 1 and 4.

Genus: PALYTHOA Lamouroux

Palythoa tuberculosa (Esper)

✓

Plates 23 and 24

TYPE: Peter Pallas was apparently the first to record this species, under the name of *Alcyonium papillosum* from the Red Sea, but his brief description being so imperfect has caused writers to use the name *A. tuberculosum* given in Esper's more critical description of this primitive coral, which he had from Tranquebar, Coromandel coast, India, and which was deposited in the Nuremburg collections.

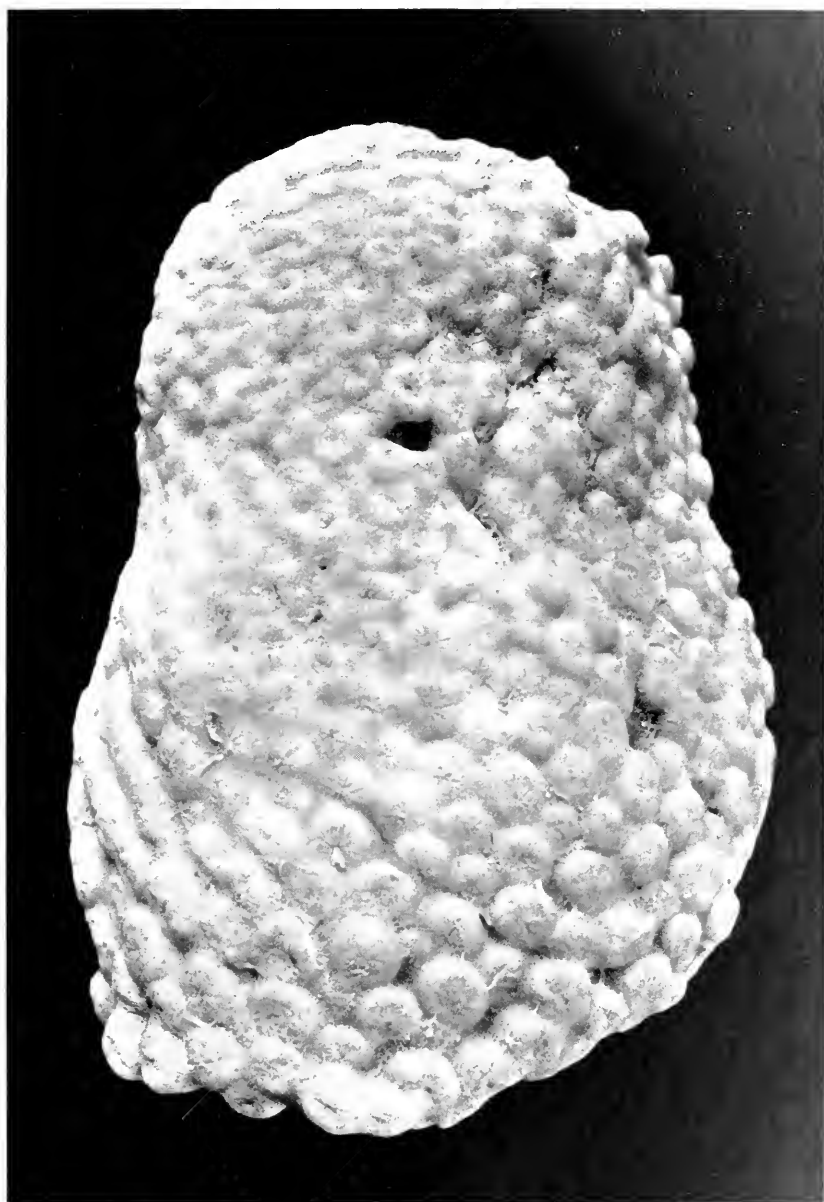
DISTRIBUTION: This species is widely distributed in the littoral zone of the Indo-Pacific.

MATERIAL EXAMINED: Two colonies, collected in shallow water, Teviatea Reef, Raiatea Island, Society Islands, August 21, 1931, by the "Alva." One colony, about 2.5 centimeters high, oval, 10.5 centimeters long and 9.5 centimeters wide taken in one fathom, low tide, Kaneohe Bay, Oahu, Hawaiian Islands, December 15, 1928, by the "Ara."

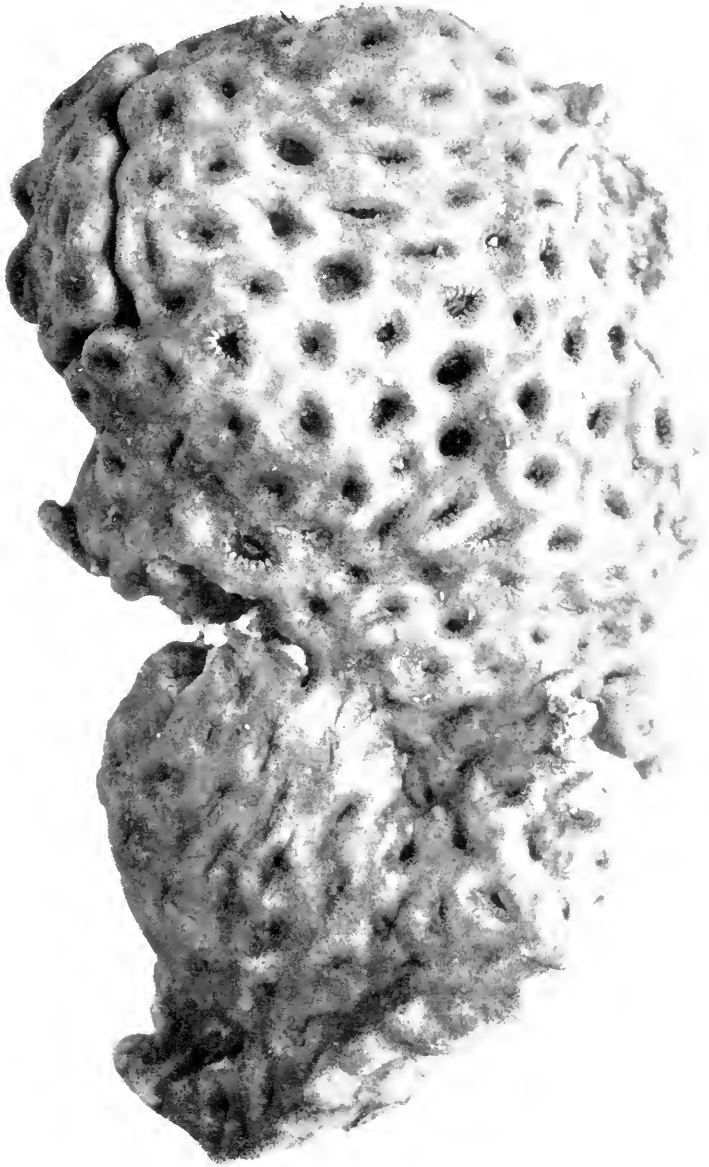
COLOUR: Dana records the polyps as varying from brownish yellow to bright greenish yellow.

TECHNICAL DESCRIPTION: The larger colony has a length of 125 millimeters, a width varying from 30 to 45 and in places 55 millimeters, and a height of 11 to 15 millimeters.

The polyps are united to their surface forming an explanate, coriaceous mass, low and of irregular contour, usually adapting itself to the stones, volcanic debris or other matter to which the young colony becomes attached, this mass having certain seam-like lines where the creeping zooids have met but not entirely fused. The polyps, when contracted, have a disk diameter of 5 to 10 millimeters, the disk being marked with crenations to the circumferal margin. The tentacles range from 16 to 20 in small polyps where they are arranged in single series, and in large polyps there are as many as forty tentacles, arranged in two series, the inner series appearing the larger, at least in dead specimens. The tentacles are large, obtuse, clavate. There are 32 internal lamellae. The texture of the mass of the colony is reinforced by



Palythoa tuberculosa (Esper), colony from Kaneohe Bay, Hawaii,
nearly natural size.



Palythoa tuberculosa (Esper), colony from Raiatea Island,
Society Islands, nearly natural size.

grains of coral sand agglutinated by the slimy secretions of the polyp; as the animal grows these grains become embedded and form a calcareous body-wall from extraneous origin, reinforcing the organism.

The tentacles are externally devoid of papillae and are each a hollow tube with a minute apical aperture. Internally they communicate with the visceral cavity by a duct beneath the radial lines of the disk. The mouth is a single aperture in the center of the disk, without appendages, and opens into the stomach, which occupies the upper fourth of the interior and is connected with the visceral cavity by a series of fleshy laminae.

The visceral cavity which is cylindrical, extends to the base of the polyp-mass. This stomach has a muscular arrangement enabling it to close at the bottom. The spermatic cords border the lamellae and extend from below the stomach nearly to the bottom of the cavity, each cord being very convoluted and possessing vibratile cilia. Besides the spermatic cords there is attached to the margin of each primary lamella, just below the stomach, a pair of flat, branchia-like organs; these are transparent and under high magnification are shown to possess vibratile cilia.

REFERENCES: *Alcyonium papillosum*, PALLAS, P. S., Elenchus Zoophytorum Hay. Apud. Petrum van Cleef, 1766, p. 350.

Alcyonium tuberculosum, ESPER, E. J. C., Die Pflanzenthier in Abbildungen nach der Natur, etc., Nurnberg, 1791, Alcyon. II Thl. Forts., p. 68, taf. 23, figs. 1-2 .

Palythoa flavoviridis, EHRENBERG, C. G., Corallenthier des Rothen Meeres, p. 47, 1834, Kgl. Akad. Wissensch, Berlin, 1834, p. 47; DANA, J. D., U. S. Explor. Exped. Zoophytes, vol. VII, 1846, p. 426.

Palythoa argus, EHRENBERG, C. G., *loc. cit.*, p. 48.—DANA, J. D., *loc. cit.*, p. 427.—MILNE EDWARDS, H., et HAIME, J., Recherches et classif. des Polypiers recents et fossiles, Paris, 1848-49, Coral. t. I, p. 305.—KLUNZINGER, C. B., Korallthiere des Rothen Meeres, Th. I, Alcy. u. Malacod. 1877, (Berlin), p. 66, taf. 4, fig. 7.

MADREPORARIAFamily: **EUPSAMMIDAE**Genus: **DENDROPHYLLIA** de Blainville*Dendrophyllia manni* (Verrill)

✓

Plate 25

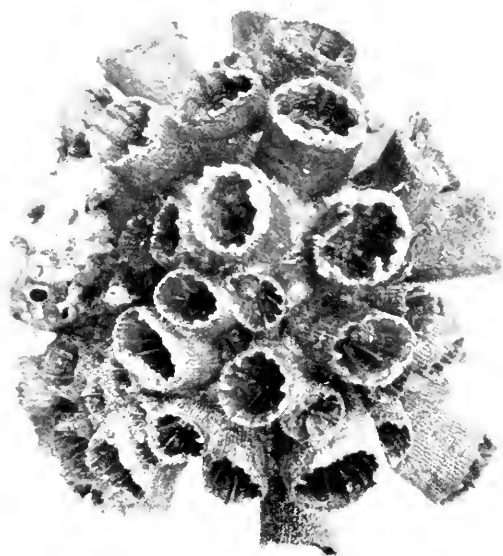
TYPE: Dr. Verrill's type was collected in the Sandwich Islands by Horace Mann and first described in the Proceedings of the Essex Institute (Massachusetts), in 1866, in his third "Synopsis of the Corals of the North Pacific Exploring Expedition," the majority of which are deposited in the United States National Museum. The first illustration of the type was given by Dr. T. W. Vaughan, in 1907.

DISTRIBUTION: This very beautiful small coral is exceedingly rare in collections, being recorded only from the two type clusters, collected at low-water mark in the Sandwich Islands and two specimens from Kaneohe, Oahu, Hawaii, collected by Dr. W. T. Brigham, deposited in the U. S. National Museum. It is restricted to the littoral zone of Kaneohe Bay, Hawaiian Islands, tide line to one fathom depth. It was not collected by the United States Bureau of Fisheries steamer "Albatross" survey of Hawaiian waters.

MATERIAL EXAMINED: Six clusters, taken in one fathom, at low tide, Kaneohe Bay, Oahu, Hawaiian Islands, December 15, 1928, by the "Ara."

TECHNICAL DESCRIPTION: This corallium encrusts rocks, forming clusters, which in the present series tend to sphaeroidal or ovoidal clusters, ranging from one to two inches high and from two to three inches across.

The corallites have the exterior closely and finely costate and covered with fine, close, granulations. Some corallites are united laterally quite to the top, others are separated distally from one to three or six millimeters; the average corallite rises six to twelve millimeters above the coenchyma; the smaller, younger ones being somewhat more numerous than the semi-isolate large corallites in some clusters, while in other clusters the large corallites predominate, these usually being separate laterally for the distal three-



Dendrophyllia manni (Verrill), from Kaneohe Bay,
Oahu, Hawaii, nearly natural size.

fourths of their length, although a few, where crowded in the clusters, are laterally united for seven-eighths of their length. The septa are in four cycles, the fourth cycle being merely slightly raised costae, very thin, uneven, and imperfectly developed. The primaries are distinctly thicker than the other series, proximally joined with the columella, widest and thickest toward the base, quite narrowed distally, the inner margin slightly concave, the distal margin not projecting beyond the wall in small corallites, but frequently in the larger corallites protruding as a small, triangular process, in which instances the marginal wall is a series of repeated concavities between these triangular elevations. The secondaries are similar to the primaries and also joined to the columella, but never extend beyond the marginal wall and are narrower and thinner than the primaries. The tertiaries are not united with the columella, frequently do not extend to the distal margin and are very thin. The columella is spongy, well developed, nearly half as broad as the cell. The cell is not quite circular, slightly oval, with the long diameter 1 to 1.5 millimeters greater than the short diameter, as 11 millimeters by 10 millimeters, or 8 millimeters by 7 millimeters in the smaller ones; the depth 5 to 7.5 millimeters.

The six clusters taken by the "Ara" have the following measurements, expressed in millimeters: Vertical diameter: 54, 55, 50, 45, 50, 50; horizontal long diameter: 72, 70, 60, 70, 60, 71; horizontal short diameter: 55, 60, 55, 55, 70 and 45.

In "The Natural History of Many Curious and Uncommon Zoophytes collected from various parts of the Globe," by the late John Ellis, Esq., F.R.S., systematically arranged and described by the late Daniel Solander, M.D., F.R.S., London, 1786, there is an illustration, Plate 32, figure 1, without legend, which apparently is "No. 7, *Madrepore tibicina* Ellis and Solander." Dr. Solander's description states (*loc. cit.*, p. 154):

"*Madrepora fasciculata, ramis cylindraceis; ramulis subclavatis, fteillis obconicis profundis, lamellis nonnullis latioribus. Centra subfimplicia. Lamellae quaternae vel fexterdae reliquis multo latiores.*" No locality cited.

When Ellis and Solander's engraved illustration, plate 32, fig. 1, is placed beside Vaughan's photographic plate of Verrill's type of *Dendrophyllia manni*, the only differences apparent are of size of colony, more numerous cells and the fact that, due to drawing,

the septa in the Ellis and Solander plate appear stronger than do those in the Vaughan photograph. The Ellis and Solander plate 32, fig. 1, apparently *Madrepora tibicina* of their text, is quite possibly identical with Verrill's more recently described species, in which event the earlier name must take precedence.

REFERENCES: *Caenopsammia manni*, VERRILL, A. E., Proc. Essex Inst. (Mass.), 1866, vol. V, pt. 3, p. 30.
Dendrophyllia manni, VAUGHAN, T. W., Bull. LIX. U. S. Nat. Mus., 1907, p. 156, pl. 46, figs. 6, 6a (one of Verrill's types) ; figs. 7, 7a (Vaughan's Kaneohe Bay specimen).

Family: POCILLOPORIDAE

Genus: POCILLOPORA Lamarek

Pocillopora cespitosa Dana

†

TYPE: This species was discovered by the United States Exploring Expedition in the Sandwich Islands, and described and figured by Prof. J. D. Dana, whose type is deposited in the United States National Museum.

DISTRIBUTION: Hawaiian Islands, littoral zone: Kaunakakai and Pukoo, Molokai Island, reef at Honolulu, reef at Kahana and Waikiki, Oahu (Dana; Vaughan) ; Laysan Island (Studer).

MATERIAL EXAMINED: A small specimen, about five inches high, was collected at Honolulu, Oahu, Hawaiian Islands, December 14, 1928, by the "Ara."

REMARKS: The present material agrees in all essentials with the original description and illustrations given by Dana. Three new varieties of Dana's species were established by Dr. T. W. Vaughan (1907), all being based on Hawaiian material.

REFERENCES: *Pocillopora cespitosa*, DANA, J. D., in Wilkes, C., U. S. Explor. Exped., 1846, Zoophytes, vol. VII, p. 525, Atlas VII, pl. 49, figs. 5-5a.—VAUGHAN, T. W., Bull. LIX, U. S. Nat. Mus., p. 86, pl. 10, figs. 1-1a, 2-2a, pl. 11, figs. 1, 2. (With synonymy.)

PART III
ANNELIDA

1

PART III
ANNELIDA POLYCHAETA

1

The Polychaetous Annelida herein reported include ten species, nine of which were taken by the "Alva" World Cruise of 1931-1932, in two archipelagoes of the Indo-Pacific region, the Society Islands and the Palm Islands, Queensland, Australia. The remaining species, *Arenicola cristata* Stimpson, was taken in Bermuda by the "Alva" Mediterranean Cruise of 1933.

Lepidonotus wahlbergi Kinberg, a rare South African species, is recorded here from the Society Islands, this being the third record of the species, and the first of it outside of South African waters, as well as the first specimen deposited in an American Museum. The tropicopolitan *Hesione pantherina* Risso is recorded for the first time from the Society Islands, with complete illustration. The rare and strikingly beautiful *Phyllodoce gracilis* Kinberg, long insufficiently known, is redescribed and illustrated from Tahiti, Kinberg's type-locality. *Eunice lita* (Chamberlin) hitherto known only from a unique, collected in the Marshall Islands, is reported from Raiatea Island, Society Islands.

The species are distributed as follows:

Lepidinotus wahlbergi, Raiatea Island, Society Islands.

Amphinome rostrata (Pallas), Raiatea Island, Society Islands and Falcon Island, Queensland.

Eurythoe complanata (Pallas), Tahiti, Society Islands.

Hesione pantherina Risso, Tahiti, Society Islands.

Phyllodoce gracilis Kinberg, Tahiti, Society Islands.

Eunice afra Peters, Raiatea Island, Society Islands and Ingham Island, Queensland.

Eunice grubei Gravier, Falcon Island, Palm Islands, Queensland.

Eunice lita (Chamberlin), Raiatea Island, Society Islands.

Lumbriconereis latreilli, Falcon Island, Society Islands.

Arenicola cristata Stimpson, Cooper's Island, Bermuda Islands.

Thelepus plagiostoma Schmarda, Falcon Island, Palm Islands, Queensland.

ANNELIDA POLYCHAETAFamily: **APHRODITIDAE**Subfamily: **Polynoïnae**Genus: **LEPIDONOTUS** Leach**Lepidonotus wahlbergi** Kinberg

✓

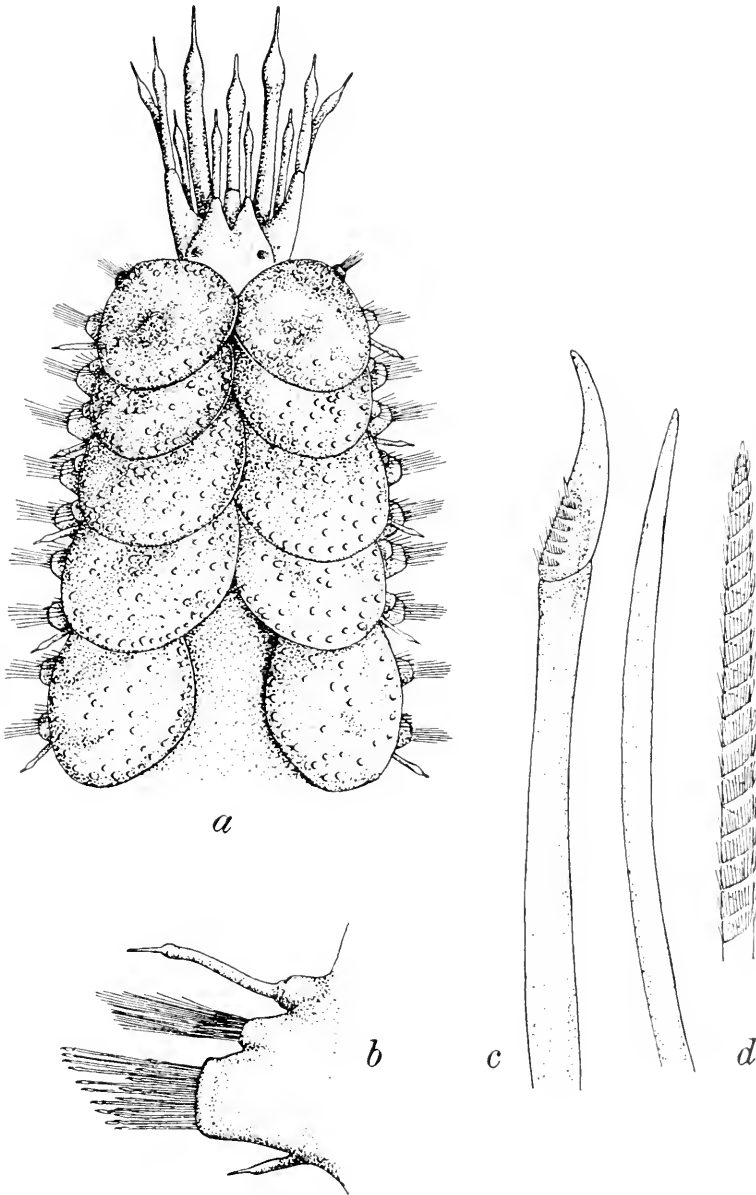
Plate 26

TYPE: The type material of this species was collected by the "Eugenie" in Natal and the Cape of Good Hope and deposited in the museum at Stockholm.

DISTRIBUTION: In addition to the type localities, this species was also taken by the "Challenger" at Sea Point, near Cape Town, South Africa, and deposited in the British Museum. It was not taken by the various "Albatross" expeditions in the tropical Pacific nor by the "Siboga" in the Dutch East Indies. The "Alva" record from Raiatea Island, Society Islands, appears to be the first record of this species from outside of the South African area. It is restricted to the littoral zone.

MATERIAL EXAMINED: One specimen, taken in reef coral, Raiatea Island, Society Islands, August 21, 1931, by the "Alva." This is apparently the only specimen of this unusual species deposited in an American museum.

TECHNICAL DESCRIPTION: The body is short, moderately fusiform, dorso-ventrally compressed, wider than high, with the dorsum slightly arched and the venter smooth, slightly concave between the two median lateral ridge-like longitudinal elevations, that tend to emphasize the squarish aspect of the body in cross-section. There is a narrow median linear groove traversing the entire length of the venter, becoming obsolescent near the peristome. The anus is large, dorso-caudad, and surrounded marginally by a colour pattern of alternate brownish-black and deep cream radiating lines. The dead specimen is 20 millimeters long and consists of twenty-seven segments. The number of pairs of elytra is twelve, only the anterior five pairs of which are present, the posterior seven pairs being indicated by large elyrophores, on somites fourteen, sixteen, eighteen, twenty, twenty-two and twenty-four, which also lack notocirri.



Lepidonotus wahlbergi Kinberg: a, head and first six somites, with the first five pairs of elytra, $\times 18$; b, a parapodium, $\times 30$; setae, $\times 204$; d, a setum, $\times 400$.

The prostomium has only the distal margin visible dorsally. This margin is comparatively straight. The median tentacle arises from a broad base, which is produced a little in advance of its distinct lateral portion, each of which supports a long, slender, ctenidium, three-fourths as long as the median tentacle and consisting of a proximal portion one-half as long, divided into twelve constricted sections, not true joints, the distal third being slenderer, composed of about six articles. The median tentacle, which is subequal in length to the lateral tentacles, has its distal portion distinctly dilated and the tip marked by constrictions, indicating three rudimentary rounded lobes distally. The bases of the lateral pair of tentacles are each dorso-lateral in position, the lateral tentacle being very flexible, constricted into twelve to fourteen sections, as is the median tentacle, and having the tip enlarged and distally bifid into two rounded lobes. The base is constricted and supports on its outer side a long, slender ctenidium which is nearly as long as the tentacle.

The eyes are four in number, small; the anterior pair being situated on the lateral prominences, and the posterior pair near the posterior margin, nearly concealed by the jugal fold.

Ventrad the prostomium presents a median concavity from which the proboscis extrudes and ectoventrad the prostomium is divided into two swollen lobes.

The proboscis is conical, moderately stout, nearly as long as the dorsal tentacle and is covered on the distal half with "papillae" or rough setae, set in transverse bands, those of the ventral portion appear to be coarsest.

The peristomium closely and evenly margins the prostomium. The first, second, third and part of the fourth segments are coalesced, or partially so, forming a somewhat subrectangular, dilated area.

Twelve pairs of elytra are normal to this species, the five pairs which are present, arise from somites two, four, six, eight and ten, while those broken off, are represented by cirrophores on somites twelve, fourteen, sixteen, eighteen, twenty, twenty-two, and twenty-four. The elytra are very nearly subcircular, with the free anterior margin widely rounded, projecting anteriorly over the tentacles for half their length and semiconcealing them. On its outer side, adjacent to the parapodia, the elytra is bent, but not incised; posteriorly the round free margin over-

laps the second pair of elytra. The entire dorsal surface of the first pair of elytra and the dorsally exposed portions of the remaining pairs are ornamented by many, large, rounded, bead-like tubercles, which are especially numerous on the circumferal margin. Each tubercle consists of a berry-like formation of rounded granules. The first, second, third and anterior half of the fourth pair of elytra entirely conceal the dorsal surface of the somites, whereas the posterior half of the fourth pair and the entire fifth pair of elytra have the somites exposed medially, showing the brown medial spots of the three somites beneath, with this exposed surface of the somites widening posteriorly. The impress remaining of those additional pairs of elytra now broken off indicates that this partial exposure of the medial area of the somites existed on somites twelve to twenty-four inclusive also.

The colour pattern, which is undoubtedly affected by death and preservative fluids, shows at present a distinctive, orange tinged cream body colour, with golden setae on the parapodia, the setae-tips being translucent honey-colour, irregularly maculated with brown, as though originally banded. The elytra are patterned with deep to light blackish-brown mottling interspersed with the orange-cream ground colour. Each somite, including those under the elytra, bears medially a small, irregular brown spot, in shape somewhat like the dorsal profile of a bumble-bee with wings expanded. These spots decrease in size posteriorly in ratio to the decreasing size of the somites. On the posterior three segments there is a striking colour design, consisting of irregular markings approximately longitudinal and radiating of blackish-brown alternating with the cream body colour. This pattern, as a whole, curiously reproduces the colour pattern of the head and anterior elytra and somites, so that the annelid appears to have a pseudo-head posteriorly.

A parapodium is figured (plate 26, figure b), showing the tentacle-like notocirrus, which, extended, consists of a wide notophore, supporting about twelve fairly stout annuli and a slenderer distal finger-like portion, composed of eight annuli; the twenty annuli, when extended, having a combined length about equal to that of the dorsal cluster of setae. This dorsal cluster of setae is composed of a dense, circular tuft of setae, encircled proximally by a ring of short, thick, distally acuminate simple setae, the inner setae being much longer and forming (in death) a conical brush,

the apex of which exceeds slightly the length of the notocirrus, but is shorter than the neuropodal spines. These neuropodal spines arise from a base compressed cephalo-caudad, but are much wider dorso-ventrally than the notopodal base. The neural spines are inset in double series dorso-ventrad, and together with the base form a fan-like "fin," the twelve to sixteen spines each being composite, the proximal article being stout, horn-yellow, supporting the distal article, a short, blade-like, strong, procurved distal hook, the concave face of which is channeled by a median groove, bordered on either side by an acuminate edge, which is coarsely dentate on the proximal third to half of each edge, having six to eight teeth, with the two edges distally converging to the curved, acuminate distal apex, which itself is a strong hook; the apices of these hooks and the dentate margins of the distal articles of about ninety percentum of the complex setae are directed ventrad. The neurocirrus is short, conic, not extending as far distad as the margin of the fleshy base of the setae-tuft. The neurocirrus consists of five or six thick annuli proximally and a narrowed distal, finger-like part, composed of four or five annuli. The first anterior and last or caudal pair of parapodia are greatly reduced in size, in ratio to the other pairs.

REFERENCES: *Lepidonotus wahlbergi*, KINBERG, J. E. H. Kongl. Svenska Fregatten Eugenies, under C. A. Virgin, Zool., III, Annulaten, 1857-1910, p. 384, (separate (p. 12), pl. 4, fig. 14 a-h.—MCINTOSH, WM. C., Rept. Voy, H. M. S. "Challenger" Zool., 1885, vol. XII, p. 66, pl. 11, fig. 1, pl. 18, fig. 8, pl. 10a, figs. 15, 16.

Aphrodita squamata, PALLAS, P., Misc. Zool., Animal. Spec. 1766, p. 91, (exparte) Kinberg *dixit*.

Family: AMPHINOMIDAE

Genus: AMPHINOME Brugiere

Amphinome rostrata (Pallas)

1

Plate 27

TYPE: Pallas states of his type: "*In ultimo Orientis Oceano habitat & Amboyna maxime adfertur.*"

DISTRIBUTION: This species has been repeatedly recorded from the littoral zone of the tropical areas of the Pacific, Indian and Atlantic Oceans and has likewise been taken on driftwood in these areas many times.

MATERIAL EXAMINED: One specimen, broken, 54 millimeters long, taken in coral, at Raiatea Island, on the reef, Society Islands, August 21, 1931. Two specimens, measuring respectively about 40 and 48 millimeters long, were collected on the reef, at Falcon Island, Palm Islands, Queensland, Australia, by the "Alva."

REMARKS: These three specimens, taken at localities so widely separated, agree in all details of diagnostic characters of the aborescent branchia, the structure of the setae and other essentials with the accepted descriptions and illustrations of the species.

The broken specimen from Society Islands has eighty-two somites. The smaller Australian specimen has fifty-eight somites, while the larger one has sixty-five somites.

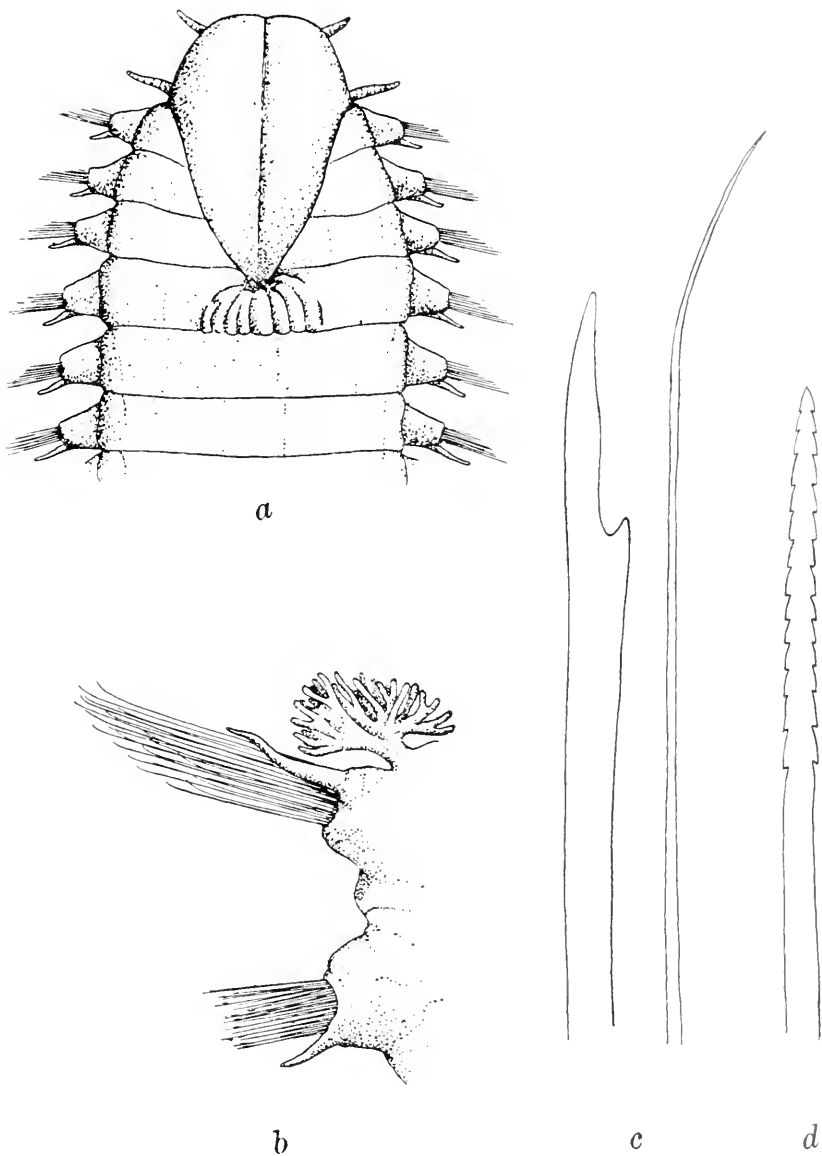
Amphinome rostrata, M'INTOSH, W. C., Rept. Voy. H. M. S. "Challenger" Zool., 1885, vol. XII, Annelida, p. 21, pl. 1-a, fig. 16.—FAUVEL, P. A., Mem. Indian Mus. Calcutta, 1932, vol. XII, No. 1, p. 44 (with synonymy).

Amphinome pallasii, QUATREFAGES, A. de, Hist. Nat. Annelides et d'Eau douce, Annelides et Gephyriens, 1865, p. 314.

Pleione tetraedra, MILNE EDWARDS, A., in Cuvier, G. J. Regne Anim. Illustré Annelides, 1849, pl. 7, bis, fig. 1.

Pleione vagans, SAVIGNY, DE, J. C., Syst. des Annelides, in Descript. Egypte Hist. Nat., 1809, (1822), t. XXI, pt. 3, p. 60, Paris.

Amphinome vagans, DE BLAINVILLE, H. M. D., Dict. Sci. Nat., 1828, t. LVII, p. 451.—CHAMBERLIN, R. V., Mem. Mus. Comp. Zool., 1919, vol. XLVIII, p. 27.



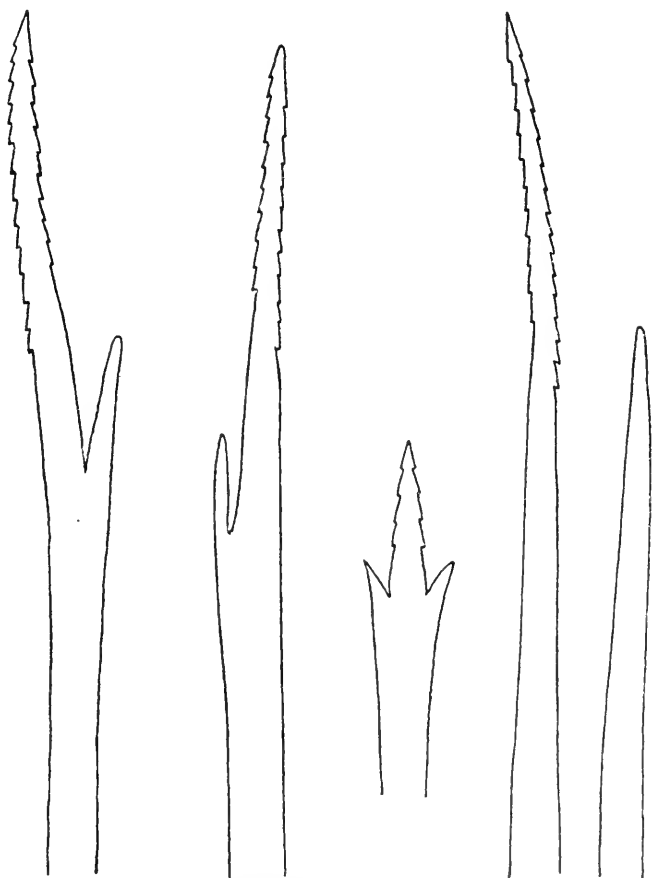
Amphinome rostrata (Pallas): ventral view of the head and adjacent somites; b, a parapodium of the twenty-fifth somite, $\times 25$; c, setae from the parapodium, $\times 115$; d, apical portion of a setum, greatly enlarged, showing the marginal teeth.

Genus: **EURYTHOE** Kinberg**Eurythoe complanata** (Pallas)

✓

TYPE: Pallas' type description refers to Gronovius' record from the Caribby Isles and especially cites Antigua; he also refers to Patrick Brown's Jamaica record, and states that the illustration presented is made from specimens collected in his own travels and deposited in his museum.

DISTRIBUTION: This species is practically circumtropic in the littoral zone of the Atlantic, Pacific and Indian Oceans.



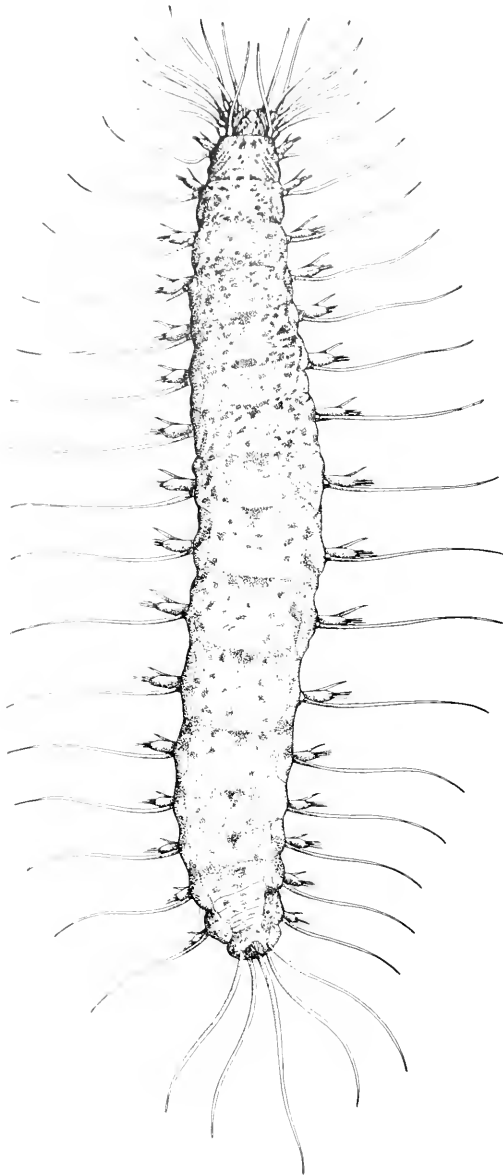
Text figure 5.—*Eurythoe complanata* (Pallas): apical portions of typical setae from a parapodium, $\times 200$.

MATERIAL EXAMINED: One specimen, taken on Venus Point Reef, Tahiti, Society Islands, August 15, 1931, by the "Alva."

REMARKS: The single specimen taken on Venus Point Reef, Tahiti, Society Islands, measures about 30 millimeters long (dead and shrunk), and consists of thirty-two somites. This specimen conforms in all essentials with previous descriptions of the species. The present specimen has thirty-two somites; the body is dorso-ventrally flattened, about twice as wide medially as high. The prostomium is oval and bears four eyes; the tentacles are short, the median tentacle being shorter than the lateral ones, no longer than the caruncle. The caruncle extends to the fourth segment. There are four buccal segments. The notopodial and neuro-podial setae are each articulated and are shorter than the setae. The dorsal cluster of setae are set in a dense brush-like tuft. These setae are long and of three principal types: (a) straight, needle-like type with serrate or spinulate lateral margins and an acuminate tip; (b) a similar, bifurcate type, very acuminate, the smaller branch being one-fourth to one-fifth as long as the larger branch which flares outward obliquely distally and usually has both lateral margins serrulate, and (c) a stout, straight, smooth, needle-like setae. The ventral cluster of setae are similarly set in a dense tuft. These individual setae are relatively thicker and sometimes have their bifurcate branches less unequal, varying from one-half to one-eighth as long as the major branch distad and serrulate. A few have a median longer branch distad, with a short acuminate branch on either side. These occur near the pygidium. The acicula are short, spear-headed.

Typical setae from the "Alva" specimen are figured. These are distinctive from those figured by Dr. Chamberlin, from a young specimen from Papeete (his plate 14, figure 8), in that the present specimen has the lesser branch of the setum furcation longer and slenderer in ratio to the longer branch, being about one-fifth to one-fourth as long and more narrowly acuminate, while longer branch is also finely acuminate distally and has the outer lateral margin especially spinose or serrulate, the inner lateral margin being less so. (Figure 5.)

REFERENCES: *Aphrodite complanata*, PALLAS, P., Misc. Zool., 1766, p. 109, pl. 8, fig., 1926.



Hesionc pantherina Risso, dorsal view, $\times 2.5$.

Eurythoe complanata, LANGERHANS, P., Nova Acta Acad. Caesareae Leop. Carol., 1881, vol. XLII, p. 108.—CHAMBERLIN, R. V., Mem. Mus. Comp. Zool., 1919, vol. XLVIII, p. 28, pl. 14, figs. 3-8-9, (with extensive synonymy).—FAUVEL, P., Mem. of the Indian Mus. Calcutta, vol. XII, No. 1, 1932, p. 45, (with additional synonymy).

Family: **HESIONIDAE**

Genus: **HESIONE** Savigny

Hesione pantherina Risso

✓

Plate 28

TYPE: Risso's type came from the Mediterranean Sea, in the vicinity of Nice, littoral zone, and is deposited in the municipal museum in Nice.

DISTRIBUTION: This species, originally described from the Mediterranean Sea, has since been many times reported from the littoral zone of the tropicopolitan areas of the Atlantic, Pacific and Indian Oceans. The "Alva" specimen appears to be the first record of this species from the Society Islands.

MATERIAL EXAMINED: One very fine specimen, taken on Venus Point Reef, Tahiti, Society Islands, August 15, 1931.

TECHNICAL DESCRIPTION: The praestomium is triangular, nine-tenths as long as wide proximally with the distal apex narrowed and rounded anteriorly. The dorsal surface of the head is defined into three lobes, the anterior median lobe and two lateral lobes, these being defined by a pair of curved depressions, one on each side, which extend inward from the base of the tentacle toward the center, but continue caudad separately, defining a median posterior area, which is separated by a short transverse sulcus from the anterior median lobe. There is a single small tentacle which arises lateroventrad, at the outer terminus of the above-described sulcus; this tentacle is composed of about seven incomplete annuli, is a distally subacute and extends to the anterior margin of the praestomium. Two pairs of eyes are present, the anterior pair being the large, subcircular and the posterior pair ovoid. The eyes are all small, sessile, blackish-brown pigment spots.

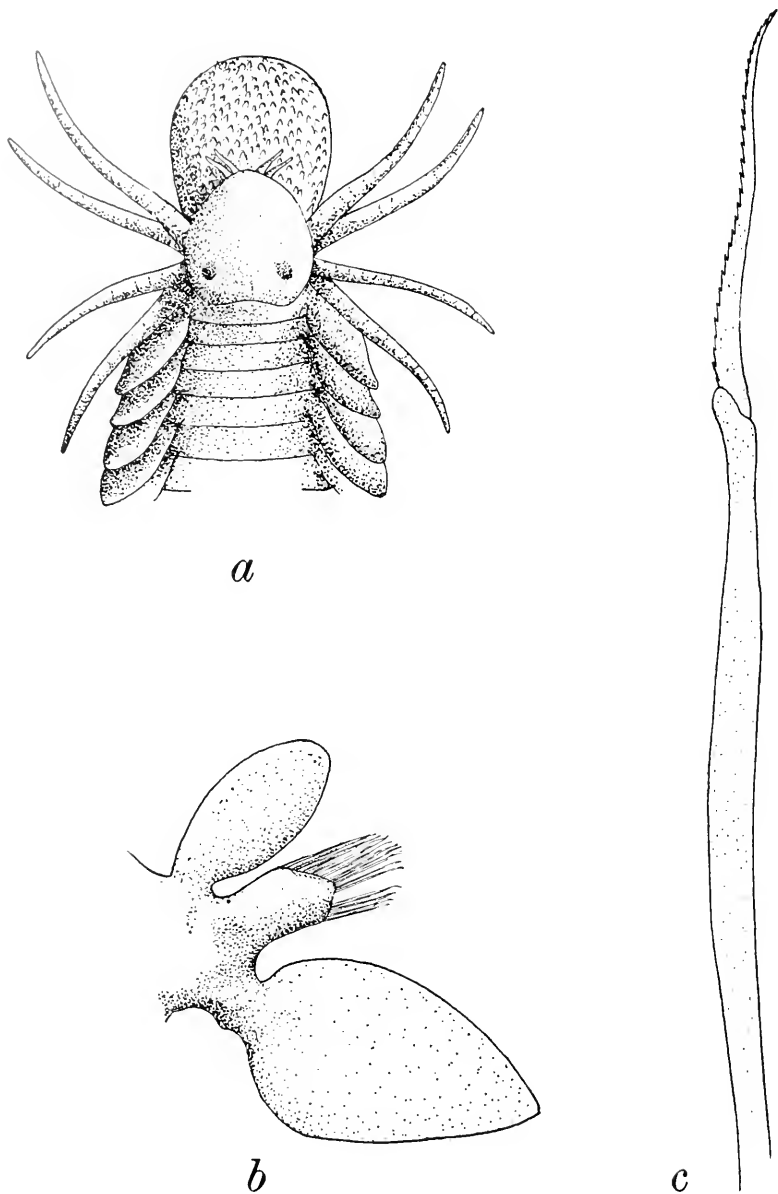
Eight pairs of tentacular cirri are present, four pairs of cirri being borne on either side by the partially coalesced first, second, third and fourth segments. Each of these cirri arises from a distinct bulbous peduncle and is composed of numerous annuli forming a very flexible, long, slender, tapered, white tentacle.

The peristome forms a thick lip continuous ventrad surrounding the aperture. This lip is decidedly wrinkled longitudinally by muscle constrictions.

The body is fusiform, attaining its greatest diameter from the sixth to tenth somites and decreasing in size cephalad and caudad, with the related parapodia proportionate. There are eight pairs of tentacular cirri and sixteen pairs of setigerous parapodia. The body is cylindrical dorsolaterally with distinct suture lines defining the cushion-like lateral prominences which project from the anterior to the posterior margin of each segment and which support the parapodia. Each of these cushions is marked by several prominent vertical wrinkles. The anus is terminal, slightly dorsad, with two cirri on each side. The venter is flat with a conspicuous papillose area just posterior to the peristome and is also papillose in the median ventral line.

The parapodium consists of a well-developed process, protruding stiffly from the body as a stout, fleshy cone, compressed in the cephalo-caudad direction and distally truncate and setigerous. The notocirrus arises from near the base dorsad and slightly caudad to the setigerous lobe and consists of a base about one-fourth as long as this median lobe, which supports a tapered, white, thread-like multi-articulate tentacle, which is equal in length to about two and a half times the total length of the parapodium with the setae included. The neurocirrus similarly arises one-third of the length from the base of the parapodium, but is without a distinct peduncle, the slender, multi-articulate cirrus arising from the ventral wall of the parapodium, which it scarcely or not at all exceeds in length. The acicule extends obliquely through the fleshy parapodium, with the short, black, thorn-like acute apex protruding slightly dorsad to the setae.

The setae are deep-set within the supporting parapodium and are golden yellow or light amber, complex, consisting of a long, strong basal shaft which terminates obliquely distally and supports an articulated distal hook-like blade, which always has on its concave margin a distal and a subdistal tooth and frequently



Plyllodoce gracilis Kinberg, from Venus Point Reef, Tahiti: a, head and adjacent somites, $\times 12$; b, a parapodium from somite one hundred, $\times 35$; c, a typical compound setum, $\times 200$.

from two to four additional teeth spaced down this margin. The complex spines are all of this pattern, differing only in the degree of length, the more dorsally situated setae being the longer, both in the proportions of the shaft and the distal blade.

This annelid takes its specific name from the fancied resemblance of its colour pattern of mottled chocolate brown on a creamy groundcolour to that of a panther. The Tahiti specimen retains such a colour design on the dorsal and lateral surfaces, the cirri being entirely cream, as is also the ventral surface. This striking colour pattern of the annelid blends with its normal habitat beneath the sun-flecked, moving waves and shifting sands to render the annelid inconspicuous in the coral reef crevices or muddy tide pools it frequents.

REFERENCES: *Hesione pantherina*, RISSO, A., Hist. Nat. de l'Europe Merid. et environs de Nice et des Alpes Maritimes, 1826, t. IV, p. 418.

Hesione (Fallacia) pantherina, M'INTOSH, W. C., Rept. Voy. H. M. S. "Challenger" Zool., 1885, vol. XII, p. 184, pl. 19, fig. 1, pl. 32, fig. 16, pl. 15a, fig. 10.

Hesione pantherina, FAUVEL, P. A., Polychetes Errantes in Faune de France, Paris, 1923, t. V, p. 233, fig. 87 (with synonymy); Mem. of Indian Mus., Calcutta, 1932, p. 60 (synonymy).

Family: PHYLLODOCIDAE

Genus: PHYLLODOCE Savigny

Phyllodoce gracilis Kinberg

✓

Plate 29

TYPE: Kinberg's type specimen came from the Society Islands and was deposited apparently in the Royal Zoological Museum of Stockholm.

DISTRIBUTION: In addition to the type locality, Augener has described *P. ovalifera* from Australia, which is doubtfully considered synonymous with *gracilis*, and more recently Fauvel has, with expressed doubt, referred a specimen from the Andamans to

this species. Lack of material for comparison leaves the matter unsettled. The "Alva" specimen, from Tahiti, appears to be the second record of *P. gracilis* from the type locality.

MATERIAL EXAMINED: One specimen, taken on Venus Point Reef, Tahiti, Society Islands, August 15, 1931.

TECHNICAL DESCRIPTION: The colour of the entire specimen and its appendages is a rich deep black with an opalescent greenish-blue iridescence when wet.

The head, which is dorsoventrally compressed as usual, is cordate, is one millimeter wide proximally and 0.9 millimeters long and has the posterior margin sinuate, the free margin convex and narrowed anteriorly; the dorsal surface convex, with two sinuate separate small furrows, one each extending posterior from behind the submedian tentacle, the two furrows defining a narrow median area on the dorsad of the head, which appear to be normal and not due to death, etc. The dorsal posterior margin of the head is sinuate, being slightly produced and concave in the median area and curved forward convexly on either side. The first or anterior pair of tentacles is the longer of the two pairs, being about 0.7 millimeters long and as thick proximally as long, distally tapered, extending beyond the head, along its lateral margin, almost to the posterior border. The second pair of tentacles is immediately posterior and slightly dorsad to the first pair, but is only 0.5 millimeters long, thick proximally, but more abruptly tapered distally. The one pair of eyes is situated in the median lateral area, being separated well. Each eye is a large, subcircular, elevated, convex black organ, with the visual range chiefly laterodorsad.

The body is very long, slender, and much tapered posteriorly. There are about four hundred and fifty-six somites present, the hinder portion of the specimen being unfortunately broken off. The width of the anterior portion of the body, measured about the fifth somite, exclusive of the parapodia, is 1.5 millimeters wide, about the two hundred and twenty-fifth somite it is 1 millimeter wide and about the four hundred and fiftieth somite it is only 0.8 millimeters wide. The somites are quite convex dorsally. The venter is flat with a distinct neural furrow which is more prominent anteriorly. The specimen measures about 185 millimeters long; broken.

The parapodia are uniramous, lateral, well developed in depth, almost attaining the vertical diameter of the body anteriorly and

being quite subequal thereto posteriorly. In length the parapodia of the anterior region are equal to about one-third of the width of the somite and posteriorly the parapodia approach one-half of the width of the related somite.

The first and second somites are coalescent, the first being incomplete dorsally. The third somite is distinct. Setae are present on the second and third tentacular somites. The tentacular cirri each have a distinct, bulbous, basal joint. The first tentacular cirrus is about 1.4 millimeters long, composed of about fourteen annuli and is conical, tapered to a slender tip. The second tentacular cirrus, adjacent and ventral to the first, is similar, but only 1.3 millimeters long and consists of about twelve annuli. The third cirrus consists of about sixteen annuli and is about 1.5 millimeters long. The fourth tentacular cirrus is also composed of fourteen annuli and is about 1.5 millimeters long. The first notocirrus is much smaller than those following and is adjacent to the base of the tentacular cirrus, nearly lateral in position. The succeeding notocirri, each of which is supported on a large cirrophore and are elongate-ovate, nearly lanceolate, typical representatives being shown in plate 29, figure a.

A typical parapodium, from somite one hundred, is shown. It consists of a large neurocirrus, in the form of a subreniform, bulbous organ, arising slightly post-ventrad to the neuropodium and being subequal thereto, or only a trifle longer and thicker. This neuropodium is a strong, subcylindrical process, compressed in the cephalo-caudad direction, with the distal end obtusely truncate, with an entire presetal lip and an entire postsetal lip. The acicule is colorless, transparent, with only the blunted apex protruberant beyond the neuropodial lobe, as shown in fig. b. The setae are all complex, ten to twelve in number, set fanwise in single series. Each setum consists of a proximal cylindrical rod, distally enlarged into a nearly convex, externally spinose joint which articulates with the blade-like distal article, which is two-thirds as long as the proximal article and tapers distally to an acuminate apex; the outer lateral margin is beset with fine spinose teeth.

Phyllodoce gracilis, KINBERG, J. G. H., Ofv. Vetenskaps Akad. Forh. Stockholm, 1865, Bd. XXII, p. 240; Kgl. Svenska Fregatten Eugenies, under C. A. Virgin, Zool. III, Annulater,

1857-1910, p. 65, pl. 22, fig. 3.—FAUVEL, P., Mem. Indian Mus., vol. XII, No. 1, 1932, Calcutta, p. 69, text fig. 12.

? *Phyllodoce ovalifera*, AUGENER, H., in Michaelson, W., und Hartmeyer, R., Die Fauna Sudwest-Australiens, Ergeb. der Hamburger sudwest-australischen. Forschungr. 1905, Bd. IV, 1912-14, p. 127, taf. 2, fig. 12, und text fig. 7a-b.

REMARKS: The present species is believed by the writer to be Kinberg's *P. gracilis*, type of which was also obtained in the Society Islands, description of which, as Dr. Chamberlain has stated, is too brief for satisfactory identification. It has seemed worth while to redescribe the species, as far as the present material permits. This all-black specimen with its opalescent greenish-blue iridescences is strikingly beautiful.

Family: **EUNICIDAE**

Subfamily: **Eunicinae**

Genus: **EUNICE** Cuvier

Eunice afra Peters

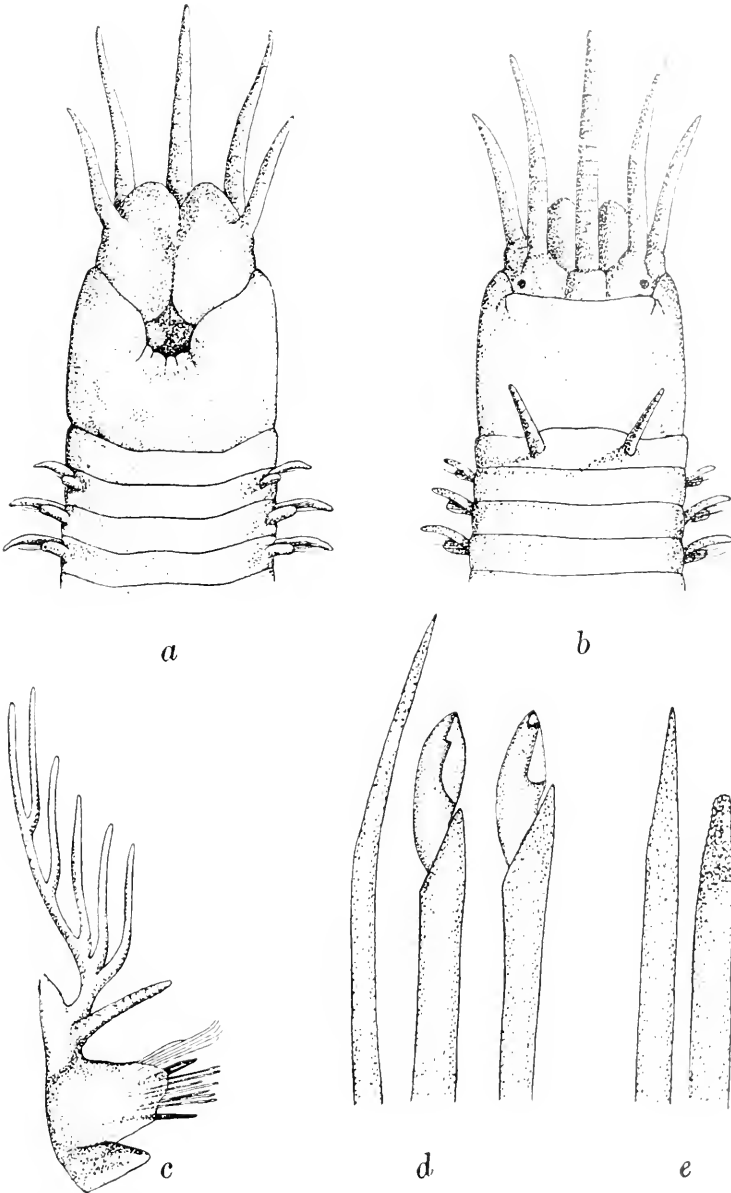
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Plate 30

DISTRIBUTION: *Eunice afra* is very widely distributed in the Indo-Pacific region, in various kinds of habitats, having been reported from the Red Sea southward on the East African coast of Zanzibar, Madagascar and the Seychelles and eastward at Ceylon, in the Maldivé Archipelago, the Mergui Archipelago, the Gulf of Manaar, the Gulf of Oman, the Philippine Islands, the Malay Seas, the Gambier Islands, New Caledonia and now by the "Alva" expedition, from Ingham Island, on the Queensland coast of Australia, and in the Society Islands.

MATERIAL EXAMINED: One specimen from the coral reef, at Ingham Island, Queensland, October 12, 1931. Three specimens, taken in coral, Teviatoa Reef, Raiatea Island, Society Islands, August 21, 1931.

REMARKS: This species, which is one of the least specialized members of the genus, possesses a high degree of variation, which



Eunice afra Peters: a, ventral view of head and adjacent somites, $\times 9$; b, dorsal view of same, $\times 9$; c, a parapodium, $\times 15$; d, typical setae from the parapodium, $\times 70$; e, acicula, much enlarged.

has led to the usual establishment of several different species names for it, now accepted as synonyms. These have been discussed by M. Fauvel (1919, also 1932). An excellent discussion of the species, based upon an extensive collection of specimens from various localities, is given by Mr. Crossland (1904), with especial reference to the variable characters.

The tentacles vary from smooth to faintly annulate. The branchia may begin from the fourth to the twentieth somite and possess from four to sixteen filaments, four to six filaments being the usual number, the branchia continuing to the posterior of the body. The acicula and related setae are dark. The body is normally subcylindrical anteriorly but wide and flattish posteriorly. the coloration of the body varies from whitish yellow to cocoa or dark chocolate or to reddish brown variably, maculated with white dots; the branchia are usually crimson, the tentacles, parapodia and ventral surface of the body usually creamy yellowish to white. The fourth setigerous somite sometimes but not always bears a distinctive collar of white, sometimes maculated with dark dots.

TECHNICAL DESCRIPTION: The following notes were made from the Society Islands specimens, which appear to be the first record of this species from this Archipelago. The body of the preserved specimen is creamy yellowish, faded, without markings; the tentacles, cirri and branchiae are slightly lighter, while the setae are yellowish and black tipped, and the acicules are black. The body is slightly narrowed anteriorly and is also narrowed moderately caudad, but the specimen is unfortunately shrunk by death and the posterior segments are broken off. The total number of segments present is fifty-eight. The length of this specimen, exclusive of tentacles, is 43 millimeters, the narrowed anterior width is 4 millimeters, the median width is 6 millimeters and the greatest width is 7 millimeters, all exclusive of the parapodia.

The praestomium is divided medially in front by a fairly deep, nearly linear vertical incision, each lobe being swollen, subpyriform, with the dilated end ectoventrad in position, the lobe being devoid of furrows. In one of these specimens the praestomium is deeply retracted within the peristome. The median tentacle is the longest, being 3.5 millimeters long, or extending to the anterior margin of the second somite. It consists of about 18 thick annuli, each being nearly as long as its related transverse diameter. The tentacle narrows moderately distad to the slender distal portion

which is bluntly rounded. The median or inner paired tentacles are similar, subequal in length, each consisting of about 18 articles. They are in contact with the peristome. The outer paired tentacles are inserted near the base of the inner pair, arising adjacent slightly anterior and but little ectad to these. The sessile eye-spot is situated dorsolaterally, outside of the base of the submedian tentacle, one black pigmented circular eye on each side. The outer tentacles are distinctly shorter, each consists of 10 to 12 articles, similar but relatively slenderer than the median pair.

The peristome is smooth, 2 millimeters long, or equal to the combined length of the next two and two-thirds somites. The anterior margin is straight on the dorsum but has a dual incision on each side, these two sinuses enclosing a small rounded lobe. There is a faint linear sulcus, running inward obliquely ventrad from the lower incision. Below the aforementioned small lobe a sinuous furrow defines basally the protruberant swollen anterior margin and median area, or lower lip. The anterior margin of this ventral lip is widely, rather deeply V- or U- shaped, concave.

The second somite is fused laterally with the peristomium in the usual way of members of this genus but is distinct above and below. Each tentacular cirrus is short, being about one and one-half times as long as the second somite, decidedly annulate, there being seven thickish articles.

The third to fifty-eighth somites are regular, undivided, short, 1 to 1.5 millimeters long, or from six to eight times wider than long. Dorsally the somites are arched convexly, of moderate length; the posterior twenty segments have a median longitudinal sulcus. The venter is flattish, with a narrowed, definite, neural furrow extending its entire length. The posterior segments and pygidium are broken off in all three specimens from the Society Islands.

The parapodia are medium to short in length, compressed in the cephalo-caudad direction, the anterior ones being more so as well as smaller. In the cephalic or caudal view they have the contour shown in figure c. The parapodia are thickish proximally especially on the neuropodial lobe. The notocirri arise from the dorsal of the base of the parapodia; each is a slender tubular or finger-like process, distinctly articulated, consisting of 12 or 14 rings each, the annuli being only three-fifths as long as thick; the apex bluntly rounded. The notocirri increase in size notice-

ably gradually from the first to seventh anterior segments and similarly decrease in size caudad as usual. The neurocirri are very nearly uniform throughout the somites, those of the third to ninth anterior segments being very little smaller than those of the successive segments. Each neurocirrus has a rather fleshy thick basal portion completed by a distinctly defined, conic distal finger-like article.

The pectinate setae occur with a fair regularity from the twenty-seventh somite onward on alternate somites. Each pectinate setum is ventral in position on the parapodium to the setae cluster and acicule, and has its distal end unequally dilated, so that the distal subcircular face is readily applied as a grasper to the surface of the coral rock; this subcircular face of the pectinate setum is cut into a series of rough, rounded nodes (giving a miniature cobble-stoned effect).

The ventral acicule is next above the pectinate setum. The acicula are visible externally from the third somite on, caudad, the fourth somite shows the tips of both the dorsal and ventral acicula as do also the succeeding segments. The visible portions of the acicula are short, projecting only for a short distance beyond the parapodia and are basally yellowish, conical, tapered to a very acuminate black tip, the acicula of the anterior somites lying in close proximity, whereas farther back they are more separated, one being dorsal and adjacent to the large tuft of setae and the other similarly ventral. On the somites forming the anterior third of the specimen the tip of the acicula are acuminate, but on the somites of the median third, the hinder portion being absent, the acicula have their tips corrugate into several coarse lobes, forming two to three blunted teeth, as shown in figure e; these teeth being present especially toward the ventral side. All the acicula are procurved forwards.

The ventral or neural cluster of setae, adjacent to the ventral acicule, are set in a cluster of three rows of about five setae each, these rows being arranged cephalo-caudad in position; the spines of the anterior row being the longest of the series and these distinctly decreasing in length dorsad. The longest, or most ventral setum, bears proximally an articulated spine on either side of the base. This and all other setae of the series are procurved ventrally and are composite. The distal articles of the composite setae are figured in fig. d. The proximal joint or shaft is strong, distally

oblique, augmented by a node on the proximal distal angle. The articulated distal article consists of a blade, roughly triangulate, with the outer margin convex, the inner concave, with an apical and a subapical sharp tooth, also one at the proximal angle. The dorsad setum of the series also bears on the outer side three evenly spaced, articulated small spines. The median row of setae is spaced with the first setum more ventrad than the first one of the first series and with the others intermediate in position between those of the first series, these setae of the second series are similar to those of the first series except that they are shorter and that neither of the outermost two spines has any supplemental articulated setae. The posterior or third series of spines are placed in alternation with those of the preceding series; the spines of this third series are greatly reduced in length but of thick circumference distally and obliquely truncated with the distal angles dilated into corrugate rounded nodes, augmenting the short, dentate distal blades.

The related notocirral cluster of spines arises adjacent to the foregoing neural cluster and extends very obliquely dorsad. This notocirral cluster consists of six setae in all arranged in fanlike series, of gradually increasing lengths from the ventral to dorsal setae. The setae, 1, 2, 3, 4, and 5, are each composed of a long slender, bowed or curved proximal article, which supports a distal slender, tapered acuminate article, while setum 6, most dorsal of the series and longest, is also stouter and has its outer lateral margin regularly sharply toothed on both articles, there being 8 to 10 such teeth, spaced along the side of both joints.

The branchiae begin on somite XVIII as a simple filament, only one-fourth as long as the related. The second branchia is like the first except that it is longer, being two-fifths as long as the related cirrus. The third branchia is subequal in length to the second one, but has the tip subequally bifid for one-half the length of the branchia. The fourth branchia is equally biramous and is two-thirds as long as the cirrus. The fifth branchia, somite XXII, are two-thirds as long as the cirrus and are two-branched, the distal article being slightly the longer. The sixth branchia is the first tribranchiate, with the proximal or innermost branch being slightly the longest branch, exceeding the cirrus by one-fifth of its length and slenderer than the cirrus, while the second branchial article is a trifle shorter than the third, or distad branch. The

seventh branchia is the first quadribranchiate one and has all four lobes long. This branchia distinctly exceeds the cirrus in length. The eighth to fourteenth branchiae inclusive are each quadribranchiate, the branchial series increasing in length progressively caudad. The twentieth branchia is five-lobed. The twenty-first branchia is only two-lobed. The twenty-second branchia is four-lobed. The twenty-third to thirty-second branchia inclusive are each five-lobed. The thirty-third branchia is also five-lobed but with the fifth lobe bearing a rudimentary node or lobe proximally. The thirty-fifth branchia is normally five-lobed on the right side, but on the left it is seven-lobed, the proximal first lobe being divided into three for the distal half of its length, while the other four lobes of the branchia are of normal length as in the preceding branchia. The thirty-fifth branchia on the left side is seven-lobed, the proximal three lobes here being separate throughout their entire length as are also the remaining outer four. The branchia of the opposite right side is normally five-lobed. The thirty-sixth to forty-first branchia are regularly five-lobed. Beginning with the thirty-third somite, the lobes of the branchia progressively decrease in length caudad. In the other two specimens from the Society Islands, the aberrant forms of lobe division, cited in certain somites of the above-described specimen, do not occur on the identical somites, but a similar variation in the branchia is evident on one somite in the second specimen and on two somites of the third specimen. Otherwise the branchia are typical.

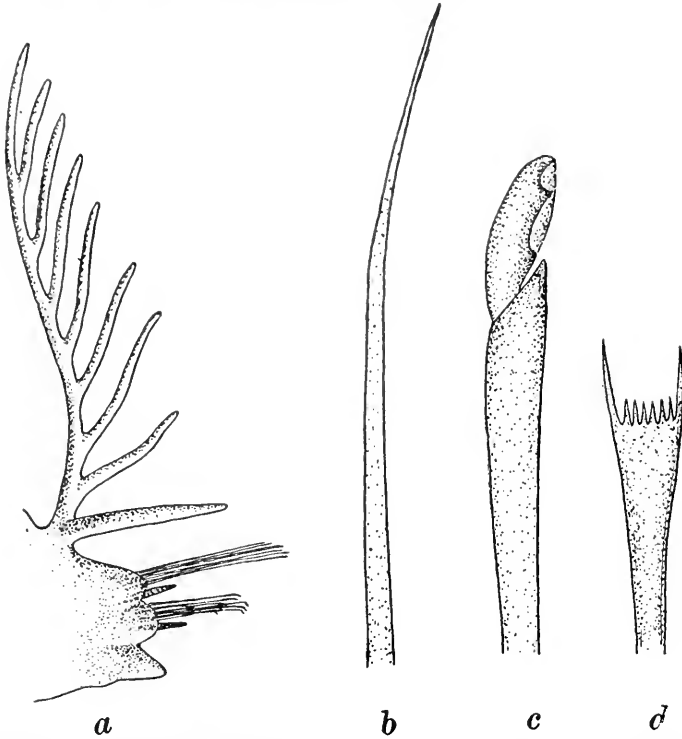
REFERENCES: *Eunice afra*, CROSSLAND, C., Proc. Zool. Soc. London, 1904, pt. I, p. 289, pl. 20, figs. 1-5.—FAUVEL, P., Archiv. Zool. Exper. et Gen., Paris, 1918-20, t. LVIII, p. 374, (synonymy); Mem. Indian Mus., 1932, vol. XII, No. 1, p. 135 (more synonymy).

Eunice grubei Gravier

✓

TYPE: M. Gravier's type was taken at Djibouti, Red Sea, and is deposited in the Paris Museum.

DISTRIBUTION: This species is widely distributed in the littoral zone of the Indo-Pacific region, having been reported from the Red Sea, East Africa, Maldivé Archipelago, the Nicobars, Amboina, New Caledonia and now from Falcon Island, Queensland.

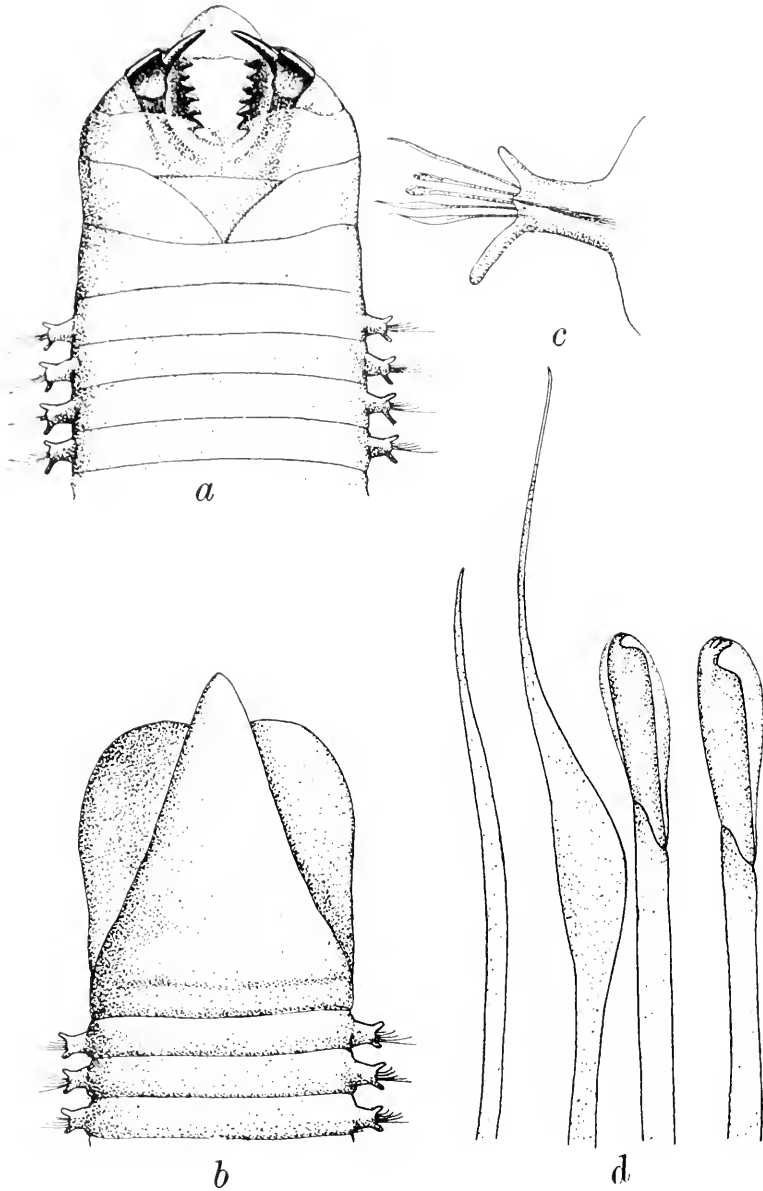


Text figure 6.—*Eunice grubei* Gravier: a parapodium with gill, of the one hundred and thirteenth somite, median part of body, $\times 12$; b, c, and d, setae from the Falcon Island, Queensland, specimen, $\times 50$.

MATERIAL EXAMINED: One specimen, imperfect, collected at Falcon Island, Palm Islands, Queensland, October 7, 1931, by the "Alva."

DISCUSSION: The diagnostic characters of this species are to be found in the tentacles, which are articulate, though sometimes only faintly so; the distribution of the gills, which begin on the third to fourth somite and continue almost to the last somites, there being from four to ten filaments per gill. The acicula are yellow or dark; the acicular setae are bidentate. The setae figured are from the Falcon Island specimen.

REFERENCES: *Eunice grubei*, GRAVIER, C., Nouv. Archiv. Mus. Paris, 1900, ser. 4, t. II, p. 258, pl. 14, figs. 87-88.—FAUVEL, P., Mem. Indian Mus., Calcutta, 1931, vol. XII, p. 36, (with synonymy).



Lumbriconereis latreilli Audouin and H. Milne Edwards: a, ventral view of head and adjacent somites, showing exposed mouthparts; b, dorsal view of head and adjacent somites, $\times 20$; c, a typical parapodium, much enlarged; d, typical setae from a parapodium, greatly enlarged.

Eunice lita (Chamberlin)

✓

TYPE: Dr. Chamberlin's type specimen was collected in the Marshall Islands, depth 12 fathoms, and was deposited in the United States National Museum.

DISTRIBUTION: This species appears to be recorded only from the type locality, the Marshall Islands, depth 12 fathoms, the "Alva" specimen from the Society Islands, coral reef, being the second time the species has been reported.

MATERIAL EXAMINED: One specimen, taken in coral, Teviatea Reef, Raiatea Island, Society Islands, August 21, 1931, by the "Alva."

REMARKS: The present specimen, which has the posterior portion broken off, consists of seventy-five somites and is about 35 millimeters long, being somewhat twisted and hardened, so that it cannot be more accurately measured. It is well expanded, the tentacles, setae, branchia and other diagnostic characters agree in all essentials with Dr. Chamberlin's description and illustrations of his type.

REFERENCES: *Leodice lita*, CHAMBERLIN, R. V., Mem. Mus. Comp. Zool., 1919, vol. XLVIII, p. 240, pl. 54, figs. 6-10, pl. 55, figs. 1-7.

Subfamily: **Lumbriconereinae**

Genus: **LUMBRICONEREIS** de Blainville

Lumbriconereis latreilli Audouin and Milne Edwards

✓

Plate 31

TYPE: This was collected in the Chaucey Isles, and Mediterranean coast of France and is deposited in the Paris Museum d'Histoire Naturelle.

DISTRIBUTION: This annelid is very widely distributed, both in bathymetric and geographic occurrence, having been recorded variously from the littoral zone and also from true deep-sea stations, of the Atlantic Ocean, Mediterranean Sea, Red Sea, Persian

Gulf, the Indian Ocean and Pacific Ocean, northward in Japanese waters and down the East African coast, also in the New Hebrides, Amboina and now in Flores Strait.

MATERIAL EXAMINED: One specimen, somewhat broken, dredged in 140 fathoms, in Flores Strait, off Larantuka Village, Flores Island, Dutch East Indies, October 22, 1931, by the "Alva."

DISCUSSION: The single specimen taken by the "Alva" agrees well with all the diagnostic characters of the species given by M. Fauvel and Mr. Crossland, respectively. The head and typical setae from the Flores Straits specimen are figured. The "Alva" specimen appears to be the first record of this species from the Flores Strait, a locality, however, which is well within the known geographical region inhabited by this Annelid.

The praestomium is tapered, bluntly conical, dorso-ventrally compressed, quite papillose. The mouth parts are figured. The body is subcylindrical, slightly flattened ventrally, narrowed anteriorly, attaining the greatest width about the twelfth to eighteenth somite. The somites are short and wide and very numerous. A typical parapodium is figured. These are well developed and have the lobe supporting the setae well developed, especially on the posterior somites. The setae are of three kinds: capillaries, complex or jointed compound setae and needle-like, unjointed crochets. The acicular articles are also figured.

COLOUR: Mr. Crossland describes the colour of the living specimen as being bright pink. The present preserved material is a deep creamy flesh color.

REFERENCESS *Lumbriconereis latreilli*, AUDOUIN, J. V., and MILNE EDWARDS, H., Ann. Sci. Nat., Paris, Zool., 1834, ser. 2, t. II, p. 381; Recherches Hist. Nat. Littoral de la France, etc., Paris, 1832-34, t. II, p. 168, pl. 3-B, figs. 13-15.—CROSSLAND, C., Proc. Zool. Soc., London, 1924, p. 10, text fig. 8 (with synonymy).—FAUVEL, P., Mem. Indian Mus., Calcutta, 1931, vol. XII, p. 152 (with synonymy).



Arenicola cristata Stimpson, from Cooper's Island, Bermudas;
specimen greatly reduced.

Family: **ARENICOLIDAE**

Genus: **ARENICOLA** Lemarek

Arenicola cristata Stimpson

✓

Plate 32

TYPE: Mr. Stimpson and a Lt. Kurtz, U. S. A., collected the type of this species in the lower portion of the littoral zone, on the shore of Maurice's Island, inside of Pelican Point, at the entrance of Charleston Harbor, South Carolina. It is deposited in the collections of the Boston Society of Natural History.

DISTRIBUTION: This species has been recorded from the temperate and tropical shores of the littoral zone of the Atlantic Ocean and also from the Mediterranean at Naples. The following valid records have been published: coast of New Jersey (Webster); tidal line, Anglesea, ten miles north of Cape May, New Jersey (Ives); Chesapeake Bay (Wilson); abundant at Charleston Harbor, South Carolina (Stimpson); from Bermuda Islands (Webster; Verrill; Boone); Manatee River, west coast of Florida (Ives); Captiva Key, Florida (Ehlers; Chamberlin); common on the shores of the Antillean Seas; Jamaica, St. Croix, Virgin Islands (Lutken); Bluefields, Jamaica (Ashworth and Gamble); Naples (Horst; Chamberlin; Ashworth and Gamble); Naples: rare; occurs chiefly among decaying matter in the Porto mercantile, breeding from June to August (Lo Bianco).

MATERIAL EXAMINED: Seven specimens taken on Sandy Beach, Cooper's Island, Bermuda Islands, June 20, 1933, by the "Alva" Mediterranean Cruise.

COLOUR: This of the South Carolina type specimens was described by Mr. Stimpson as follows: "The colour of the animal is a rich dark green of various shades, often approaching to brown on the middle of the body. A dark coloured median line extends along the ventral surface. The circular ridges are of a light brown colour; the setae of a bright golden hue; and the proboscis, reddish brown." Of the series of specimens from several localities, examined by them, Messrs. Gamble and Ashworth wrote: "The living specimens are a dark velvety bottle green with some yel-

lowish and bluish iridescence; the branchia and proboscis are reddish; the notopodial setae golden yellow."

HABITAT: It occurred in the third and fourth subregions of the littoral zone, living in holes in the hard sand, which it had excavated to a length of two feet. These holes were exactly adapted in width to the thickness of the animal, and were not furnished with a lining of any kind. They extended obliquely downward, being at first perpendicular, but curving so as to become almost horizontal; the lower extremity was about one foot below the surface. The locality where they were found was not exposed to the action of breakers, but was within the harbor, so that a slight deposit of mud covered the sand in which they lived. All the specimens were found in their holes, with the anterior extremity downward, and when taken, were trying to escape by digging still further into the sand, which is effected by continued rapid evolutions of the proboscis. The specimens, when handled, gave out a greenish colouring matter, which stains the skin in such a manner that it cannot be removed for many days. (Stimpson).

In 1890, Mr. J. E. Ives reported the third finding of *Arenicola cristata* within the United States coast; his specimens were taken from a large colony concealed within the sand, along the edge of a pool of water formed by the washing over of the sea, at Anglesea, New Jersey.

All writers concur in stating that this species is of rare occurrence at Naples; Lo Bianco (1899) reported that it occurs there chiefly among decaying matter in the Porto mercantile, breeding from June to August.

EGGS AND LARVAE: In his type description Stimpson states; "During the latter part of March, we frequently observed in and about the holes of these worms great quantities of a soft transparent jelly, filled with minute, brownish specks, which proved to be eggs."

In 1883, Dr. Edmund B. Wilson, of Johns Hopkins University faculty, published a valuable, well illustrated paper describing his observations on egg-masses and larval stages of *Arenicola cristata*, made during two seasons' work at the Chesapeake Bay Zoological Laboratory of Johns Hopkins University. He stated:

"The eggs are embedded in huge gelatinous masses, which assume various forms as they are swayed to and fro by the tide. A common form is irregularly cylindrical, three or four feet long

and as many inches wide. Sometimes they are rounded and shapeless, lying flat on the sand; in other cases they are as long as six feet and more and from one to three inches in diameter. The eggs are small, 13 millimeters in diameter, nearly spherical or slightly ovoid, very opaque and are enclosed in a thick chorion, which seen by oblique light appears to be perforated by minute radiating pores. The yolk is a light cinnamon color. Segmentation is almost equal and the embryo gradually elongates and when 18 to 24 hours old acquires a belt of cilia, in front of which two eye-spots appear, and a broad band of cilia also appears on the ventral surface. The first pair of setae appear on the third day, and the mouth is by that time distinct. The larvae hatch on the third day and swim freely for a day or two. The notopodial setae are first formed, appearing from above downwards; the neuropodial setae appear at the end of the third or beginning of the fourth day. The larvae then secrete a gelatinous tube, sink to the bottom of the vessel and creep about there. There they lived for more than three weeks and by the end of that time possessed eleven to twelve setigerous segments."

HISTORY: This limnivoruous Polychaete, one of the largest species found along the Atlantic coast of the southeastern United States and in the West Indies, has attracted the interest of numerous scientists, the original description of the species presented by Stimpson (1856) having been augmented by Christian Lutken's (1864) description of West Indian specimens from St. Croix and the shores of the Antilles, under the name of *Arenicola antillensis*, which was additionally recorded by Ehlers (1887), from Captiva Key, Florida, collected by the United States Coast Survey Steamer "Blake." In 1865 Prof. H. E. Webster, of Union College, New York, gave the first record of this species from Bermuda, where it was collected by Dr. G. Browne Goode. In 1879 the same author reported the species from a fragmentary specimen taken on the coasts of New Jersey.

The first record of *Arenicola cristata* from Naples was given by Dr. R. Horst (1889), who found there two adult specimens, also two immature specimens, possibly of this species.

Mr. J. E. Ives, writing in the Proceedings of the Philadelphia Academy of Natural Sciences, 1890, reported a colony of *Arenicola cristata* from Anglesea, New Jersey, and also specimens from the Manatee River, west coast of Florida.

Dr. Lo Bianco (1899) described this species as being one of rare occurrence in Naples.

The second record of the species from the Bermudas was given by Dr. A. E. Verrill, of Yale University, in 1899, and in 1907, this author published photographs of his specimens from these Islands.

Professors F. W. Gamble and J. H. Ashworth, of the faculty of Owens College, Manchester, England, published (1900) a memoir on "The Anatomy and Classification of the *Arenicolidae*, with some observations on their Postlarval Stages," which contains an exhaustive account of *Arenicola cristata*, excellently illustrated.

DIAGNOSTIC CHARACTERS: This species attains a length of twelve to sixteen inches and a diameter of one inch. The prostomium is well developed, consisting of a median and two lateral lobes; the branchia occur in eleven richly pinnate pairs on somites seven to seventeen, inclusive, and the nephridia in six pairs on somites five to ten inclusive; the posterior somites and pygidium are characterized by the absence of branchia and parapodia; these somites frequently but not always have small cirriform processes. The anterior portion of the body is usually more enlarged than the posterior. *Arenicola cristata* is one of the five valid members of the genus and is readily distinguished by possession of the most profusely pinnate branches found in this genus.

The brain is well developed, having anterior, median and posterior lobes. The otocysts are closed spherical sacs, each containing a single, large, spherical chitinous otolith, which is believed to be formed by the secretions of the walls of the vesicle and apparently increases in size throughout life.

The nephridia are in six pairs, opening on somites five to ten. These nephridia have the dorsal lip well supplied with flattened, spatulate ciliated vascular processes; the ventral lip is entire, ciliated. The oesophageal pouches are represented by only one pair, which is variously cylindrical, clavate, or conical in shape. The diaphragmatic pouches are large, finger-shaped. The gonad is small. The ova are spherical, with a moderately thick vitelline membrane. The segmentation of the ova is complete, but somewhat unequal.

REFERENCES: *Arenicola cristata*, STIMPSON, Wm., Proc. Boston Soc. Nat. Hist., 1856, vol. V, p. 114.—WEBSTER, H. E., 32nd Ann. Rept. N. Y. State Museum Nat. Hist., 1879, p. 117.—WILSON, E. B., Studies from Biol. Labr. Johns Hopkins Univ. 1883, vol. II, p. 278, pl. 21, figs. 35-62, pl. 23, figs. 3, 4.—WEBSTER, H. E., Bull. XXV, U. S. Nat. Mus. 1884, p. 323.—HORST, R., Notes of Leyden Mus., 1889, vol. XI, p. 43.—IVES, J. E., Proc. Phila. Acad. Nat. Sci., 1890, vol. XLII, p. 73.—LO BIANCO, S., Mitth. Zool. Stat. Neapel, 1899, Bd. XIII, p. 484.—VERRILL, A. E., Trans. Conn. Acad. Arts and Sci., 1895-99, vol. X, p. 599.—GAMBLE, F. W. and ASHWORTH, J. H., Quarterly Jrn. Micros. Sci., 1900, vol. XLIII, p. 432, pl. 22, figs. 1, 2, pl. 23, figs. 13-17, pl. 24, figs. 30-33, pl. 27, fig. 65, pl. 29, fig. 81.—VERRILL, A. E., loc. cit., vol. XII, p. 147, photo fig. 141.—CHAMBERLIN, R. V., Mem. Mus. Comp. Zool., 1919, vol. XLVIII, p. 394.

Arenicola (Pteroscolex) antillensis, LUTKEN, CH., Vidensk. Meddel. f. Naturhist. Foren. i Kjobenhavn for Aaret, 1864, p. 120.

Arenicola antillensis, EHLERS, E., Mem. Mus. Comp. Zool., 1887, vol. XV, p. 173.

Family: **TEREBELLIDAE**

Genus: **THELEPUS** Leuckart

Thelepus plagiostoma Schmarda

†

TYPE: This was collected in New Zealand and is deposited in the Zoological Museum in Leipzig.

DISTRIBUTION: This species is known from the tropic and sub-tropic littoral zone of the Pacific and Indian Oceans, being known from the Indian Ocean, Japan, Australia, New Zealand, Chile and California. The "Alva" specimen from the Queensland coast adds another station for this interesting Polychaete.

MATERIAL EXAMINED: One specimen, collected on the shores of Falcon Island, Palm Island, Queensland, October 7, 1931, by the "Alva."



Text figure 7.—*Thelepus plagiostoma* Schmarda: four views of the uncini, showing the basal knob and main fang, above which is seen a transverse row of a pair of teeth and median tooth; from the Falcon Island specimen.

DISCUSSION: This specimen, which has the praestomium more deeply retracted and consequently somewhat difficult to decipher, appears to agree in all essentials with that figured for the type. It is about 12 centimeters long. The posterior portion of the body is moderately swollen, then tapered, forming a short, nearly smooth cone, composed of numerous, densely crowded, small somites, most difficult to accurately decipher in the shrunken specimen. The abdominal pinnules are small, not protruberant; not found on the last few somites. The dorsal capillary setae are not found on the last eleven uncinigerous somites. The uncini have a basal knob and the main fang, above which there is a transverse row of a pair of teeth and a median one.

REFERENCES: *Terebella plagiostoma*, SCHMARDA, L. K., Neue wirbellose Thiere, II, Leipzig, 1861, p. 41, pl. 24, fig. 196 (color).

Thelepus plagiostoma, AUGENER, H., Polychaeta II, Sedentaria. Die Fauna Sudwest Australiens, 1914, Bd. V, p. 95, Jena (synonymy); Vidensk. Meddel. Kjobhavn, 1926, vol. LXXXI, p. 239.—FAUVEL, P., Archiv. Zool. Exper. Gen., Paris, 1919, t. LVIII, p. 455, fig. 10; Mem. Indian Mus., Calcutta, 1932, vol. XII, p. 233 (synonymy).

PART IV
ECHINODERMATA

7

PART IV
SYSTEMATIC DISCUSSION
ECHINODERMATA

1

The Echinoderm collection obtained by the "Alva" World Cruise of 1931-32, herein reported, comprises the second part of this report, including the Crinoidea, Ophiuroidea and Holothuroidea, the Asteroidea and Echinoidea having been reported in Part II, Volume VI, Bulletin of the Vanderbilt Marine Museum.

Some of the Echinoderms obtained by the "Ara" World Cruise of 1928-29 are also included in the present report. These include Crinoidea, Asteroidea, Ophiuroidea, Echinoidea and Holothuroidea.

The "Alva" explorations in Floridian waters, in 1933 and 1935, are here represented by valuable hauls containing *Cidaris abyssicola* (A. Agassiz).

One Echinoid obtained by the "Alva" South American Cruise of 1935 is also included in the present report. This is an exceptionally fine series of the rare *Brisaster moseleyi* (A. Agassiz), from Chile.

With the exception of these Floridian deep water and Chilean sea urchins, the sea-tars, sea-lilies, serpent-stars, sea urchins and sea-cucumbers secured by the "Ara" and "Alva" are all, except one pelagic holothurian larva, representatives of the littoral fauna of the Indo-Pacific region, where the unrivalled beauty of their exquisitely coloured, fragile bodies glides with indescribable gracefulness, like shadowy silhouettes from an enchanted sea, in the tropic waters of the tidal zone and coral reefs of the Indo-Pacific archipelagoes of the Society Islands, Hawaiian Islands, Fiji Islands, Samoan group, Anambas Islands, Philippines, Cochin China Coast, the Dutch East Indies, and the Palm Islands, Queensland.

Asteroidea

Only two species of the sea-stars obtained by the "Ara" World Cruise are included in the present report. One of these is the lovely cobalt blue *Linckia laevigata* (Linné) herein recorded from the Hawaiian Islands, this species having been also obtained by

the "Alva" World Cruise. The second species is the vermilion *Pentaceraster alveolatus* (Perrier), highly interesting in its variability, even as exhibited in the small series obtained by the "Ara" in Philippine waters. The distribution of these sea-stars is as follows:

Linckia laevigata Linné, Kaneohe Bay, Oahu, Hawaii.

Pentaceraster alveolatus (Perrier), Zamboanga, Philippine Islands.

Crinoidea

The Crinoidea are represented by five species, all members of the superfamily Comasterida, three of which were collected in the Dutch East Indies, by the "Alva," as follows:

Comatula pectinata (Linné), Durian Straits.

Comaster gracilis (Hartlaub), Flores Straits.

Lamprometra protectus (Lutken), Bali.

The remaining two species were collected in the Anambas Islands, South China Sea, by the "Ara," as follows:

Comanthus samoana A. H. Clark, 3.2 miles S.S.E. of Pulo Telaga Island.

Amphimetra ensifer (A. H. Clark), 3.2 miles S.S.E. of Pulo Telaga Island.

Ophiuroidea

The Ophiuran collection of the "Alva" World Cruise of 1931-32 includes nine genera represented by twelve species from five archipelagoes—the Samoan, Fiji, Society, Palm (Queensland), Bali and Seba-Seba Bay of the Sunda Isles.

The three species from Ingham Island, Queensland, are each of unusual interest. *Amphioda ochroleuca* (Brock), hitherto known only from the type, a single specimen taken in Amboina and deposited in the Gottingen Museum, is now represented in the Vanderbilt Marine Museum by three specimens from Ingham Island, which greatly extend the known range of the species. The rare and lovely *Ophiaetis brocki* de Loriol, likewise known only from the type and taken at Amboina and deposited in the Geneva Museum, is here represented by two specimens from Ingham Island and seventeen from the Society Islands, indicating an

extensive Indo-Pacific distribution for this species. *Ophiarthrum pictum* (Muller and Troschel), which apparently has its center of distribution in the Philippines-New Guinea area, is now recorded from southeastern Queensland coast.

Four species represent the Society Islands fauna, namely, the above-mentioned rare *Ophiactis brocki* de Loriol; the exquisite circumtropic *O. savignyi* (Muller and Troschel); *Ophiocoma scolopendrina* (Lamarck), represented by a series of brittle-stars ranging from 3 to 20 millimeters disk diameter, and *Ophiolepis cincta* Muller and Troschel.

The Samoan Island fauna is represented by a single species, the above-mentioned *Ophiocoma scolopendrina* (Lamarck) with a series of very large adults.

Two magnificent specimens of the conspicuously lovely *Ophiomastix lutkeni* Pfeffer, so rare in museum collections, were collected in the coral reefs of Bali and establish the best series of this species within Occidental museums.

Two species of *Ophiothrix*, *longipeda* (Lamarck) and *striolata* Grube were brought up clinging to the "Alva's" anchor chain, from a depth of 14 fathoms in Seba-Seba Bay, as was also a specimen of *Ophiocnemis marmorata* (Lamarck), while a fourth species, *Ophiothela danae* Verrill, came up a commensal, riding the primary spines of the sea-urchin, *Prionocidaris baculosa* variety *annulifera* (Lamarck), which was also brought up on the anchor chain, as was a specimen of *Ophionereis dubia* Audouin and Savigny.

That portion of the Ophiuran collection obtained by the "Ara" World Cruise of 1928-29 herein reported is represented by nearly a hundred specimens, of four species from two archipelagoes, the Anambas Islands, South China Sea, and the Hawaiian Islands.

The four specimens of *Ophiothrix expedita* Koehler, from the Anambas Islands, are of especial interest, being representatives of a new species discovered by the "Siboga" in the Dutch East Indies and hitherto known only from the "Siboga" specimens, which are deposited in the Leyden Museum.

The Hawaiian fauna is represented by two species of *Ophiocoma*, *lineolata* Muller and Troschel, which has a far-flung distribution in the Indo-Pacific and has been previously reported from the Hawaiian Islands, and the rare *O. wendti* Muller and Troschel here recorded for the first time from Hawaii. The "Ara" catch

contains both exceptionally large and very juvenile specimens, presenting evidence sufficient to refute the contention that *O. wendti* is merely the young of another species.

The fourth species of "Ara" catch is also Hawaiian, *Ophiactis savignyi* (Muller and Troschel), represented by sixty-eight specimens found entwined within the fronds of a new species of Hydroid, *Coryendrium splendidum* Boone.

The fifteen species of Ophiura are distributed as follows:

Amphioda ochroleuca (Brock), Ingham Island, Queensland.

Ophiactis brocki de Lorient, Society Islands and Ingham Island, Queensland.

Ophiactis savignyi (Muller and Troschel), Society Islands and Hawaiian Islands.

Ophiothrix expedita Koehler, Anambas Islands.

Ophiothrix longipeda (Lamarck), Seba-Seba Bay, Durian Straits, Dutch East Indies.

Ophiothrix striolata Grube, Seba-Seba Bay, Durian Straits, Dutch East Indies.

Ophiocnemis marmorata (Lamarck), Seba-Seba Bay, Durian Straits, Dutch East Indies.

Ophiothela danae Verrill, Seba-Seba Bay, Durian Straits, Dutch East Indies.

Ophionereis dubia Audouin and Savigny, Seba-Seba Bay, Durian Straits, Dutch East Indies.

Ophiocoma lineolata Muller and Troschel, Hawaiian Islands.

Ophiocoma scolopendrina (Lamarck), Samoa Islands and Society Islands.

Ophiocoma wendti Muller and Troschel, Hawaiian Islands.

Ophiomastix lutkeni Pfeffer, Temukus Roads, Bali, Dutch East Indies.

Ophiarthrum pictum (Muller and Troschel), Ingham Island, Queensland.

Ophiolepis cincta Muller and Troschel, Society Islands.

Echinoidea

The three species of Echinoidea contained in the present report were secured respectively by the "Alva" explorations in Floridian waters in 1935 and 1936, where a representative series of Dr. Alexander Agassiz's *Cidaris abyssicola* was taken. The second Echinoid was obtained by the "Ara" World Cruise in Hawaiian waters, establishing another record for the small urchin, *Eucidaris metularia* Lamarck, first illustrated by the Dutch naturalist, Dr. Seba, in 1734, from Amboina. The third species was collected by the "Alva" South American Cruise of 1935, in Chilean waters, where seven fine specimens of the fragile Spatangid, *Brisaster moseleyi* (Agassiz) were dredged. This rare echinoid, first taken by the "Challenger," is here figured in detail for the first time.

The distribution of these sea urchins is as follows:

Cidaris abyssicola (A. Agassiz), off Sand Key Light, Florida, 100 fathoms and in 65 fathoms off Sand Key Light, Florida.

Eucidaris metularia (Lamarck), Kaneohe Bay, Oahu, Hawaii, 2 fathoms.

Brisaster moseleyi (A. Agassiz), Relonca Inlet, Bahia de Cochamo, Chile.

Holothuroidea

The Holothuroidea of the "Ara" World Cruise are represented by two species, one of which, *Pentacta arae* Boone, from the Anambas Islands, is new to science and forms an interesting connection between existing species of the *Cucumariidae*. The second species is the comparatively rare *Euapta godeffroyi* (Semper) from the littoral zone of the Hawaiian Islands.

The Holothuroidea of the "Alva" World Cruise include the adults of four littoral species, also two larval stages of an unusually interesting *Synaptid*, taken in 140 fathoms depth in the Flores Straits. These littoral species include: *Holothuria impatiens* Forskal from Falcon Island, Queensland; *H. arenicola* Semper, establishing a second record of this species in Samoan waters; an excellent series, consisting of eleven of *Actinopyga mauritana* (Quoy and Gaimard), all from the coral reef zone of Venus Point

Reef, Tahiti, which apparently establish the second record of this species from the Society Islands. A magnificent specimen of *Stichopus horrens* Selenka, also from Venus Point Reef, Tahiti, gives apparently the first record of this holothurian from the Society Islands since Selenka's type was obtained there, about 1867.

The *Pentacula* stage of two *Synapta* species larvae, pelagic in plankton, taken in a surface to 140 fathoms depth haul in Flores Straits, present two seldom seen stages of the development of a species of this rather primitive genus.

The distribution of the Holothuroidea is as follows:

Holothuria impatiens Forskal, Falcon Island, Queensland.

Holothuria arenicola Semper, Apia, Samoa.

Actinopyga mauritana (Quoy and Gaimard), Venus Point Reef, Tahiti, Society Islands.

Stichopus horrens Selenka, Venus Point Reef, Tahiti, Society Islands.

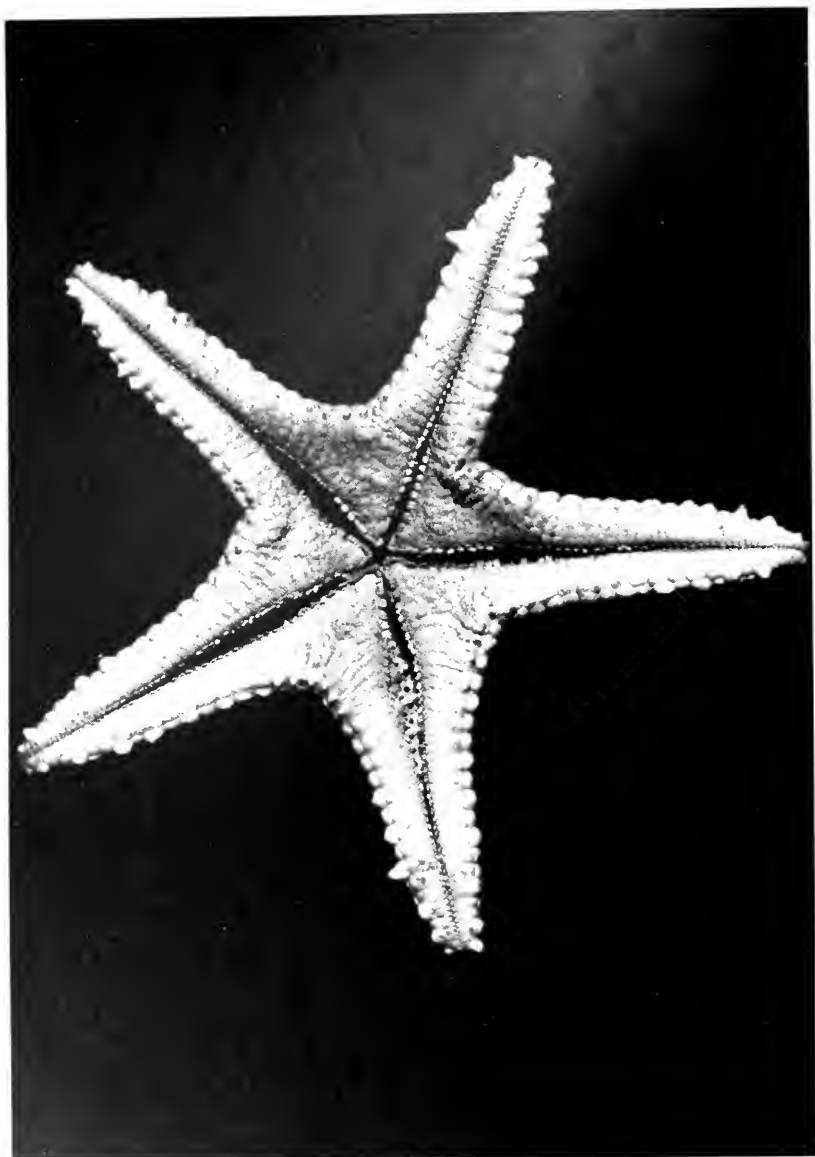
Pentacta arae Boone, mouth of Saigon River, Cochin China, 11 fathoms, and Pulo Condore Islands, South China Sea, 7 fathoms.

Euapta godeffroyi (Semper), Kaneohe Bay, Hawaii, low tide, 1 fathom.

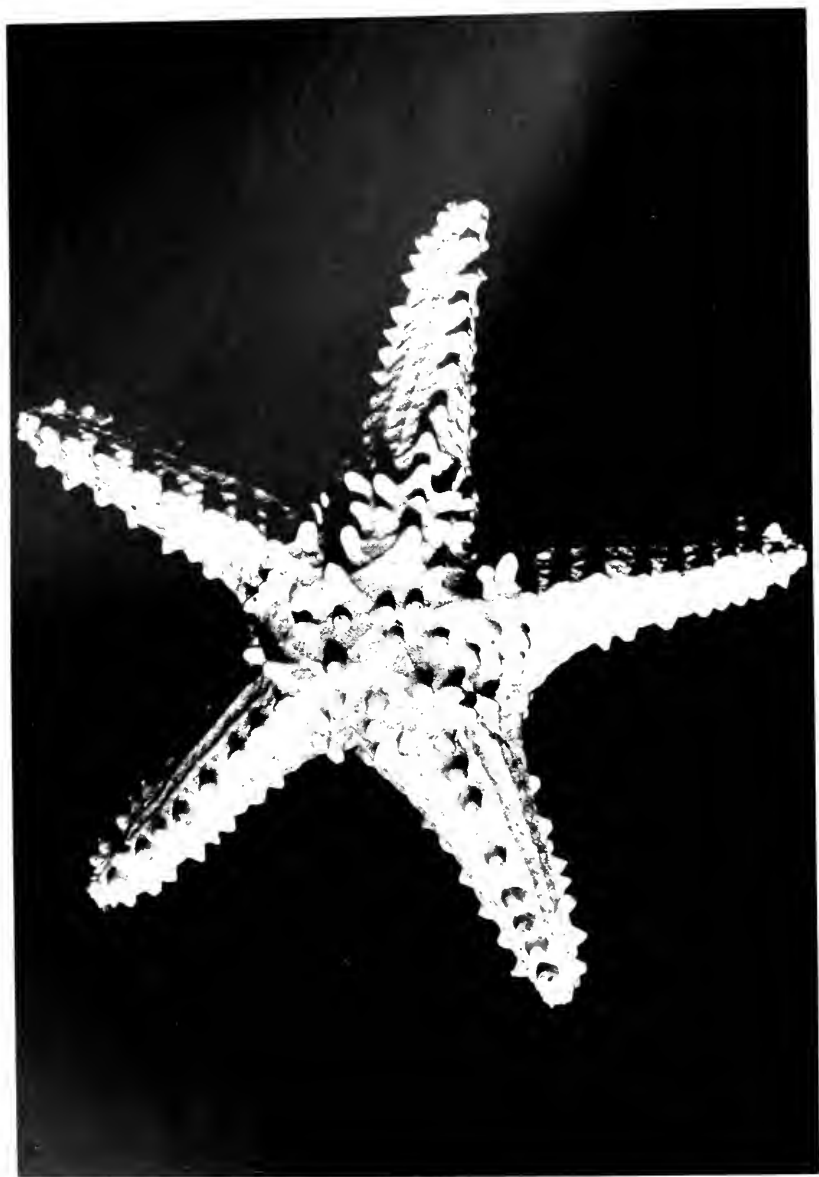
Synapta species, larvae, Flores Straits, surface to 140 fathoms depth.



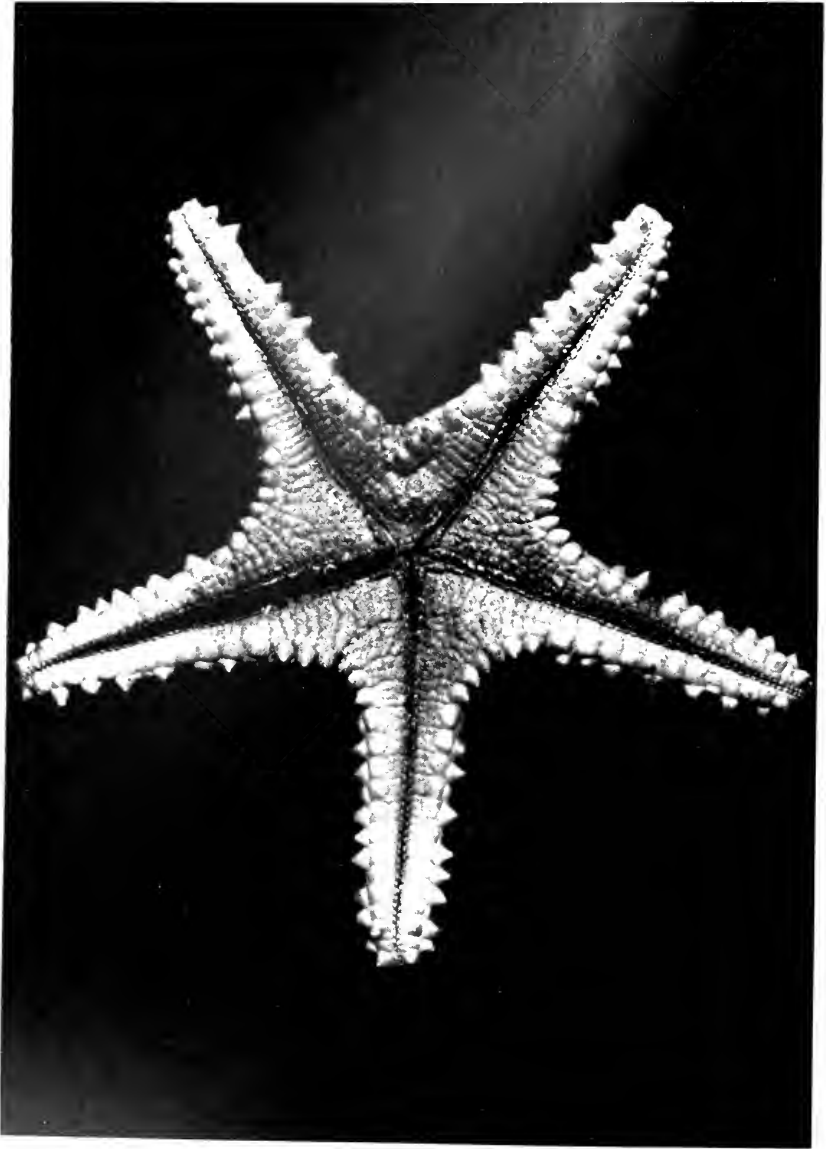
Peraster alveolatus (Perrier), abactinal view showing simple type of ornamentation, $\times 0.4$



Pentaceraster alveolatus (Perrier), actinal view of specimen shown in plate 33, showing the inferomarginal spines, $\times 0.4$.



Pentaceraster alveolatus (Perrier), abactinal view, showing a more highly developed type of ornamentation, $\times 0.4$.



Pentaceraster alveolatus (Perrier), actinal view of specimen shown in plate 35, showing more numerous supero- and infero-marginal spines, $\times 0.4$.

Asteroidea

Family: OPHIDIASTERIDAE

Genus: LINCKIA Nardo

Linckia laevigata (Linné)

†

DISCUSSION: This exquisite cobalt blue sea-star, whose beauty graces the far-flung tidal zone of the Indo-Pacific region, has been collected previously by Mr. Vanderbilt, and is fully reported and illustrated in Bulletin of the Vanderbilt Marine Museum, Vol. VI, p. 243, plates 74, 75 and 76.

MATERIAL EXAMINED: Three five-rayed specimens of average size, taken in one fathom, at low tide, in Kaneohe Bay, Oahu, Hawaiian Islands, December 15, 1928, by the "Ara."

REFERENCES: *Asterias laevigata* Linné, C., Syst. Nat. ed. X, 1758, p. 662. *Linckia laevigata* Lutken, C., Vidensk. Meddel. Kjobhavn, 1871, p. 265.—BOONE, L., Bull. Vanderbilt Marine Museum, 1935, vol. VI, p. 243, pls. 74, 75, 76.

Family: OREASTIDAE

Subfamily: Oreastinae

Genus: PENTACERASTER Doderlein

Pentacaster alveolatus (Perrier)

†

Plates 33, 34, 35 and 36

TYPE: M. Perrier's type was collected in New Caledonia by M. Germain and is deposited in the Jardin des Plantes and was illustrated by M. Koehler (1910).

DISTRIBUTION: This species, originally reported from New Caledonia (Perrier, 1875) and subsequently reported from there by Koehler (1910), was taken at nine stations by the U. S. Bureau of Fisheries Steamer "Albatross" in the Philippine region (Fisher, 1919), while Doderlein (1936), reporting the "Siboga"-Expedition Asteroidea, recorded a yet larger series from the Philippines, Sulu

Archipelago, New Caledonia and Samoa. The "Ara" specimens add another Philippine record for this highly variable species.

MATERIAL EXAMINED: Two specimens, collected at Zamboanga, Philippine Islands, January 16, 1929, by the "Ara."

COLOUR: Vermilion.

DISCUSSION: This species, which has a more restricted distribution than *P. nodosus* (Linné) known from the same area, is readily distinguished therefrom by the presence of a series of prominent distal superomarginal and inferomarginal tubercles.

The two specimens taken by the "Ara" differ conspicuously in the number and form of the large acorn-shaped tubercles of the carinal ridge of the abactinal surface; such variation has been previously discussed by Mr. H. L. Clark (1908), who had a more extensive series of twenty-seven specimens from New Guinea and Amboina, also by Mr. W. K. Fisher (1919), who reported the large "Albatross"-Philippines series of thirty-five specimens.

In specimen A of the present series (plates 33 and 34), there are nine large primary tubercles in carinal series on each of four arms, on the fifth arm eight large and one distal rudimentary tubercle. No tubercles are present in the apical area. Inter-radial large "acorn" tubercles occur one each in three instances, two in the fourth, and three in the fifth interradial area. These tubercles appear higher than their proximal diameter, but the very largest tubercles have a basal diameter subequal to the vertical diameter; the less stout tubercles average from 0.15 to 0.20 percentum greater height than the related proximal horizontal diameter. They are variously with the apex blunt or pointed, the majority of the tubercles being terminated by a blunt short conical spine, or with a lesion indicating where the spine has been abraded. The tubercles are covered by an almost continuous series of low, coarse granules of varying size and shape. None of the primary radial tubercles is bifurcate. Superomarginal spines are present, being more conspicuously, but unequally developed on the distal 0.40 to 0.50 of each ray. Inferomarginal spines are present numerously and are quite acuminate along the interbrachial areas. The large primary radial spines are slenderer than those of *Pentaceraster nodosus* (Linné).

Pedicellariae are of two kinds: (a) the long, low, bivalve, slit-like kind to be found on the trabeculae, and (b) small, erect,

forceps-like pedicellariae, located on the papular areas, these variously having the jaws subequal in length or from 1.5, 2, or 2.2 times the height of the surrounding granules. These granules of the papular areas are variously rounded, convex, or subconic.

The adambulacral armature (somewhat imperfect in the present specimen) has seven to nine furrow spines where uninjured. The subambulacral spines are two or three, heavy, with blunted apices. External to these is a second series of smaller, shorter spines of two, and more frequently three, per series. The elongate bivalve, slit-like pedicellariae are quite numerous in the area adjacent to the jaw-angle.

In the second specimen, "B" (plates 35 and 36), there are respectively 9, 11, 11, 10 and 10 primary radial tubercles on the carinal ridges of the five rays, with a cluster of three not quite so large "acorn" tubercles in the center and eight tubercles each in three interradial areas, seven tubercles in the fourth and ten in the fifth interradial area. The superomarginal spines are highly developed, being present in almost continuous series along the brachial and interbrachial margins, those of the interbrachial margin being the largest. The inferomarginal spines are quite large, six to eight present in each interbrachial area and a few large spines present near the tips of each ray.

REFERENCES: *Pentaceros alveolatus*, PERRIER, E., Archiv. Zool. Exper. et Gen., Paris, 1875, t. V. p. 75.—KOEHLER, R., Echinoderms of the Indian Museum, Pt. VI, Asteroidea II, An Account of the Shallow-Water Asteroidea, 1910, p. 95, pl. 10, fig. 1, pl. 14, fig. 8 (shows Perrier's type).

Oreaster alveolatus, BELL, F. J., Proc. Zool. Soc., London, 1884, p. 73.—FISHER, W. K., Bull. 100, U. S. Nat. Mus., 1919, vol. III, p. 341, pl. 101, fig. 1.

Pentacaster alveolatus, DODERLEIN, L., Zool. Jahrb. Syst., 1916, Bd. XL, p. 428, figs. K and L; Siboga-Expeditie, Die Asteriden III, Oreastinae, p. 332, pl. 34, figs. 1-11, pl. 25, figs. 1-7, pl. 29, fig. 10. (Dr. Doderlein considers *Pentaceros novae-caledoniae* Koehler, loc. cit. 1910, p. 104, pl. 13, fig. 6, pl. 15, figs. 3 and 4, from New Caledonia, and *Pentaceros bedoti*, KOEHLER, R., Revue Suisse Zool., 1911, t. XIX, p. 1, pl. 1, fig. 1, from New Britain, synonyms of *P. alveolatus* (Perrier).

Crinoidea

Order: **COMATULIDA**

Suborder: **Oligophreata**

Superfamily: **Comasterida**

Family: **COMASTERIDAE**

Subfamily: **Comactiniinae**

Genus: **COMATULA** Lamarck

Comatula pectinata (Linné)

†

TYPE: Linné's type of *Asterias pectinata*, deposited at Lund, came from the seas of India.

DISTRIBUTION: This species is known from Ceylon, eastward in the China Sea, south to Luzon, and down to Amboina, Thursday Island, Durian Straits, Dutch East Indies, and Singapore, in the littoral zone.

MATERIAL EXAMINED: One specimen, taken on the "Alva's" anchor-chain, Seba-Seba Bay, South Brother's Island, Durian Straits, Dutch East Indies, depth 22 fathoms, October 21, 1931.

COLOUR: Exquisite in its flower-like beauty, this sea-lily is bright carmine, the pinnules being tipped with white.

REMARKS: For full discussion of this species, consult Dr. Austin H. Clark, Bulletin 82, U. S. National Museum, vol. I, II and III, which renders further comment superfluous.

REFERENCES: *Comaster pectinata*, CLARK, AUSTIN H., Bulletin, U. S. Nat. Mus., Vol. I, 1915, pp. 23, 31, 33, 39, 45, 49, 51, 52, 75, 79, 81, 83, 220, 249, 281, 298, 321, 323, 351, 355; Ibid., Vol. II, 1921, pp. 12, 15, 71, 86, 95, 100, 102, 176, 177, 233, 245, 250, 280, 291, 292, 341, 519, 594, 597, 705; Ibid., Vol. III, 1931, pp. 10, 24, 30, 26, 39, 41, 203, 250, 274, 294, 295, 308, 320, 323, 330, 331, 335, 337, 338, 339, 359, 360, 361, 362, 363, 365, 366, 371, 372, 375, 396, 397, 398, 661, 675, 679, 692, pl. 20, fig. 49, pl. 33, fig. 100, pl. 34, fig. 101, pl. 35, fig. 102, pl. 36, fig. 103, pl. 37, fig. 104, pl. 38, figs. 105-107.

Subfamily: **Comasterinae**

Genus: **COMASTER** L. Agassiz

Comaster gracilis (Hartlaub)

1

TYPE: This was taken near Pulo Edam, near Batavia, and was deposited in the Gottingen Museum, Germany.

MATERIAL EXAMINED: One broken specimen, taken on the "Alva's" anchor chain, off Larantuka, Flores Island, Flores Straits, Dutch East Indies, October 22, 1931.

DISTRIBUTION: This species is a well known member of the littoral zone, ranging from the Maldive Archipelago eastward to New Britain, the Fiji Archipelago and Macclesfield Bank, having been recorded from the following localities: Pulo Edam, near Batavia (Hartlaub); Hulule, Maldive Archipelago, Blanche Bay, New Britain (Bell); Port Blair, Andamans, Singapore and other Malayan records, Kei Islands, Lontor and Sutare, Banda (A. H. Clark); off Larantuka, Flores Island, Flores Strait (Boone). Two sublittoral records for this species, of 13 and 55 meters respectively, are published.

REMARKS: The Flores Straits specimen is unfortunately too broken from its association with the "Alva's" anchor chain to permit of much description, beyond establishing another locality record for this very lovely sea-lily.

The colour of the living specimens recorded does not appear to have been reported.

Mr. Austin H. Clark's very lucid exposition of this species, based upon practically all known specimens of *Comaster gracilis*, is to be found in his Bulletin LXXXII, U. S. National Museum.

REFERENCES: *Actinometra gracilis*, HARTLAUB, C., Nachr. Ges. Gottingen, May, 1890, pp. 170, 187; Nova Acta Acad. German, 1891, vol. LVIII, No. 1, p. 11, p. 113, pl. 5, fig. 55.

Comaster gracilis, CLARK, A. H., Proc. U. S. Nat. Mus., 1908, vol. XXXIII, p. 686; Bull. LXXXII, pt. I, 1915, pp. 49, 52, 53; Ibid., pt. I, 1921, p. 594; Ibid., pt. III, 1931, pp. 11, 12, 428, 430 and 435, pl. 47, figs. 143, 144.

Family: **MARIAMETRIDAE**Genus: **LAMPROMETRA** A. H. Clark**Lamprometra protectus** (Lutken)

✓

Plate 37

TYPE: Lutken's List, Godeffroy Museum, at Hamburg, p. 34.

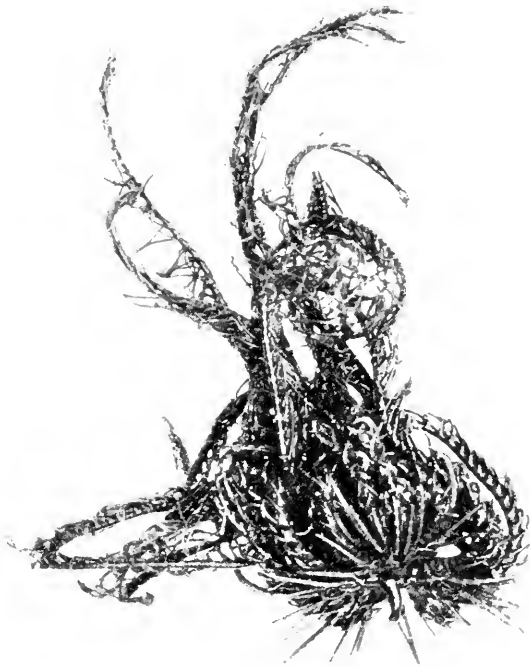
DISTRIBUTION: Littoral in the East Indies; Mergui Archipelago (Carpenter); Indian Archipelago (Hartlaub); Amboina, Thursday Island (Doderlein); Blanche Bay, New Britain (Bell); Ceylon (Chadwick) and other localities.

MATERIAL EXAMINED: One specimen, taken on coral reef, Temukus Roads, Bali, Dutch East Indies, October 25, 1931, by the "Alva."

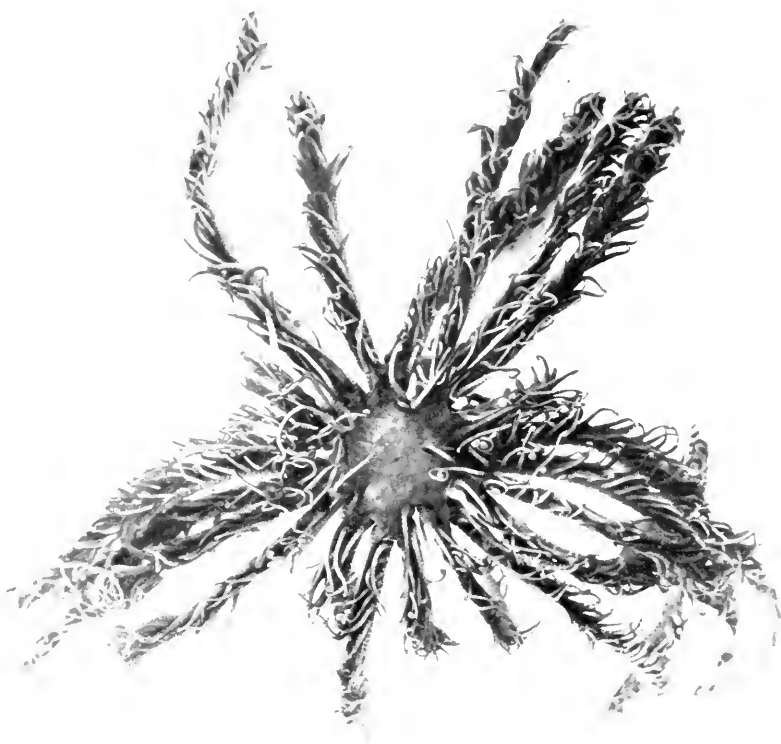
COLOUR: This gloriously coloured shallow-water species has an extensive range of colour variation, described in detail by Dr. A. H. Clark. In some specimens deep purple is the dominant tone with white, cream and yellowish markings; in others bright green; in another bright green, variegated with brown and white; a third type is black and white; a fourth is dominated by light yellow and orange with variegations, while yet another is deep blood-red with lighter shadings; a sixth form had chocolate with white markings. Several other types of variations of these primary colours in patterns of exquisite variegations have been recorded.

REMARKS: The single specimen taken by the "Alva" is shown in plate 37. Though imperfect, it conforms in the essential diagnostic characters of the species, as described and figured by Dr. Austin H. Clark (1915, 1921, 1931), who has given an exhaustive analysis of the species, including a complete lucid resume of the early history of this crinoid.

REFERENCES: *Caput-Medusae cinereum*, LINCK, H., De Stellis Marinis, 1733.*Lamprometra protectus*, CLARK, A. H., Bull. U. S. Nat. Mus., 1915, vol. LXXXII, pt. I, p. 22, also p. 399, for list of serial references; Ibid., pt. II, 1921, p. 34, description, and p. 783 for serial references.



Lamprometra protectus (Lutken), $\times 1$, from Bali.



Comanthus (Cenolia) samoana A. H. Clark, $\times 1$, from off
Pulo Telaga Island, 33 fathoms.



Comanthus (*Cenolia*) *samoana* A. H. Clark, abactinal view, $\times 1$,
from off Pulo Telaga Island, 33 fathoms.

Family: COMASTERIDAE*

Subfamily: Comasterinae

Genus: COMANTHUS A. H. Clark

Subgenus: Cenolia A. H. Clark

Comanthus (Cenolia) samoana A. H. Clark

†

Plates 38 and 39

TYPE: The type and cotypes of this species were collected by Sir Charles N. E. Eliot in Samoa; the type is deposited in the United States National Museum.

DISTRIBUTION: The geographical range of this species is from Ceylon to tropical Australia, south to Abrolhos Islands, west Australia and Torres Straits, Solomon Islands, New Caledonia, the Fiji Islands, Tonga Islands, Gilbert Islands, Samoa, Caroline Islands, Pelew Islands, and Philippine Archipelago. Dr. A. H. Clark mentions that it is apparently scarcer in the Malay Archipelago.

MATERIAL EXAMINED: One exceptionally fine specimen collected in 33 fathoms, on coral bottom, 3.2 miles S.S.E. of Pulo Telaga Island, Anambas Islands, South China Sea, February 6, 1929, by the "Ara."

The bathymetrical occurrence, given by Dr. A. H. Clark as "low tide down to 40 meters," is considerably extended by the "Ara" specimen, which comes from 33 fathoms, or 68.75 meters depth.

DISCUSSION: The specimen has twenty arms, which present an average length of 80 millimeters. The brachials and pinnules are extremely spinose on the distal margins of the brachials and pinnule segments, slightly more so than those figured by A. H. Clark (p. 257, figs. 428-429, vol. I, pt. II, 1915). The discoidal centrodorsal is small, about 3.3 millimeters diameter, with the bare polar area slightly concave. Combs occur at intervals to the tips of the arms. These combs have the pattern characteristic of this species, as figured by A. H. Clark, *loc. cit.*, p. 327, figs. 649-

*This and the following species, *Amphimetra ensifera* (A. H. Clark), collected by the "Ara" World Cruise, were added after the "Alva" Crinoidea had been printed, which explains the disrupted systematic arrangement.

651. For complete diagnosis of this exquisite crinoid, consult Dr. Austin H. Clark's exhaustive monograph.

REFERENCES: *Comanthus samoana*, CLARK, A. H., Bull. LXXXII, U. S. Nat. Mus., 1915, Vol. I, pt. I, p. 46, p. 49; *ibid.*, pt. II, 1921, pp. 149, 236, 257, figs. 428-429, pp. 278, 292, 327, figs. 649-651, pp. 594, 597, 709; *ibid.*, 1931, pp. 411, 529, 531, 593, 599, 601, 602, 628, 639, 640, 648, 649, 658, 662, 677, 679, 681, 682, pl. 78, fig. 208, pl. 81, figs. 219-220.

Family: **HIMEROMETRIDAE**

Genus: AMPHIMETRA A. H. Clark

Amphimetra ensifer (A. H. Clark)

Plates 40 and 41

TYPE: The type of this species was collected at Singapore and is deposited in the University of Copenhagen Museum.

DISTRIBUTION: Singapore (Clark), Anambas Islands, South China Sea (Boone).

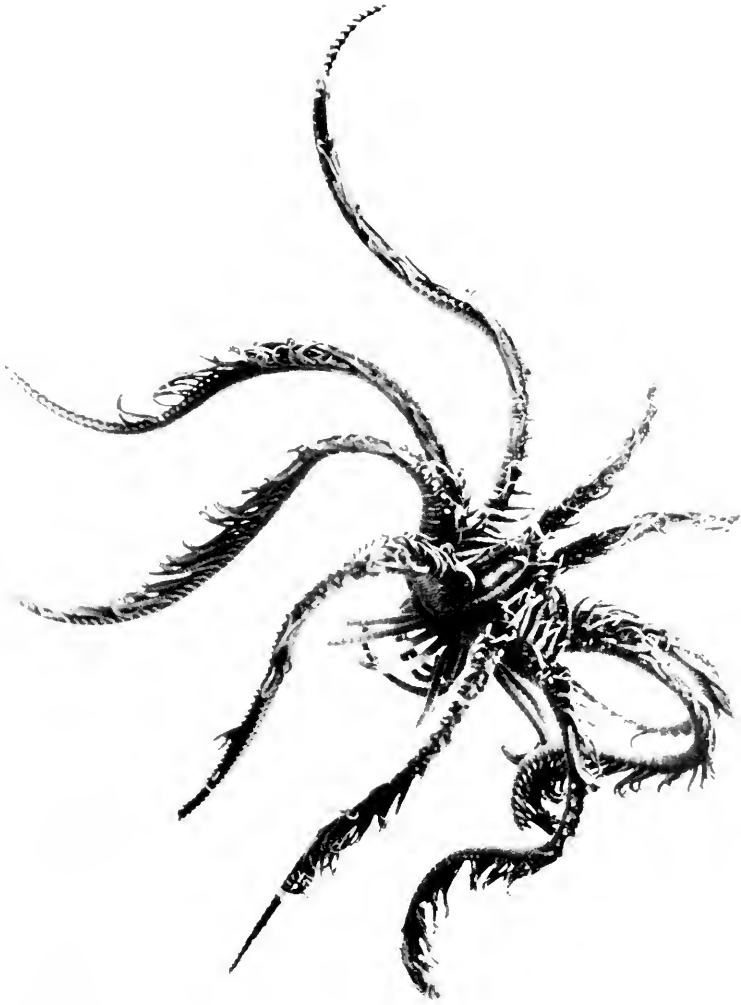
MATERIAL EXAMINED: Three specimens, taken on coral bottom, in 33 fathoms, 3.2 miles S.S.E. of Pulo Telaga Island, Anambas Islands, South China Sea, February 6, 1929, by the "Ara."

COLOUR: Mr. Vanderbilt's field note records these living sea-lilies as brown with yellow markings. Under the microscope, the specimens, now preserved nine years in alcohol, show the disk and pinnae as deep purplish brown, the arms and cirri a deep ivory yellow. The apical spines of the pinnae show as crystalline hooks.

DISCUSSION: The three Anambas Islands specimens appear to be the second catch of this unusual crinoid, hitherto known only from the type, a unique taken at Singapore and deposited in the Copenhagen University Museum. The fact that *Amphimetra ensifer* (A. H. Clark) was not taken by the extensive marine surveys of H.M.S. "Challenger," the United States Bureau of Fisheries Steamer "Albatross" surveys off the coasts of Japan and in Philippine waters, the Royal Indian Marine Survey Steamer "Investigator" nor the Nederlandsch Oost-Indie Siboga-Expeditie, all of which magnificent collections of Crinoidea have been studied by Mr. Austin H. Clark, in his classical monographs, serves to



Amphimetro ensifer (A. H. Clark), a young specimen is shown in the upper figure, a second specimen approximating the size of the type is shown in the lower figure; each $\times 1$, from off Pulo Telaga Island, South China Sea, 33 fathoms.



Amphimetra ensifer (A. H. Clark), $\times 1$, profile of the largest specimen taken by the "Ara," off Pulo Telaga Island, South China Sea, 33 fathoms.

emphasize the rarity of *Amphimetra ensifer*. The geographic distribution of the species is substantially extended to the northeast and the bathymetric range of 33 fathoms is established, placing *ensifer* among the deeper water species of the genus *Amphimetra*, which have a known distribution from littoral down to 32—possibly 36 fathoms.

The three specimens are, respectively, the young shown in the upper figure of plate 40, and one (lower figure of the preceding plate) which approximates the dimensions of the type, and a third specimen, not quite so large (plate 41). All three of these specimens have the respective centrodorsals discoidal, thick, as figured by Mr. Clark for his type; the cirrus sockets are close together, in two irregular, semialternate series. The cirri are 18 to 20 per sea-lily, 20 to 21 millimeters long each, consisting of thirty articles each, except those broken or undergoing regeneration. These joints have the proportions described in the type and are similarly tuberculate in the dorsal line from the tenth to distal articles, except on three cirri, where the tubercles begin, respectively, on the sixth, eighth and ninth articles. These dorsal spines or tubercles are uniformly strong, conical, the proximal ten to twelve being moderately developed, the distal ten being distinctly higher, except when the distal one is yet longer, about subequal; the opposed terminal claw strong, about as long as the diameter of the preceding segment, basally thick and decidedly curved, but nearly straight distally and acuminate.

The disk has a mosaic pavement consisting of small plates.

The arms, ten in number, are about eighty to eighty-five millimeters long (unbroken in the largest specimen). None is entire in the second specimen, but the three arms, almost complete, have an average length of sixty millimeters each. The cirri, twenty in number, are each 18 to 20 millimeters long. This specimen also has ten arms.

The third specimen, juvenile, has ten arms, of an average length of 30 millimeters (with tips broken off), and has fifteen cirri, of twenty to twenty-six articles apiece, the longer cirri being about 11 millimeters long, the tubercle spines beginning from the eighth joint distad, these spines being relatively longer and more acuminate in the young crinoid; the subdistal spine in each instance being 1.5 to twice as high as those preceding, and the distal claw of this young specimen, while possessing the characteristic

curvature of the species, has the abrupt curvature of the proximal portion continued into the slender distal portion. The synarthrial tubercles are present, but are less pronounced than in the larger specimen. The pinnules have the typical structure. The disk is paved with plates, as in the larger specimens.

The arms of *Amphimetra ensifer* have a structure similar to that of the better known *A. discoidea* (A. H. Clark), but the arms of *ensifer* have a distinguishing characteristic in the synarthrial tubercles which are excessively produced, those of the largest specimen being uniformly as large, or slightly larger than those figured by Mr. Clark for his Singapore type. The proximal pinnules all have squarish articles and conform to the type description in essentials. P¹ is slender, 7.1 millimeters long, with 20 articles; P² is 7 millimeters long, less slender, with 17 (rarely 18) articles; P³ is 5 to 5.5 millimeters long, like P², but with only 16 articles; P⁴ is 5 millimeters long, consisting of 13 articles, less thick than P² and P³, but not so slender as P¹.

REFERENCES: *Himerometra ensifer*, CLARK, A. H., Proc. Biol. Soc., Washington, D. C., 1908, vol. XXI, p. 225.

Amphimetra ensiformis, CLARK, A. H., Proc. Biol., Washington, D. C., 1909, vol. XXII, p. 7.

Amphimetra ensifer, CLARK, A. H., Bull. LXXXII, U. S. Nat. Mus., 1915, vol. I, Comatulids, pt. I, pp. 141, 255, 285, 328, 329, 361; Ibid., text fig. 86, fig. 256, fig. 337, fig. 474; Ibid., vol. I, pt. II, 1921, pp. 26, 29, 72, 104, 216, 228, 595; figs. 39, 40; Ibid., vol. I, pt. III, 1931, p. 32.

Ophiuroidea

Gnathophiurida

Family: AMPHIURIDAE

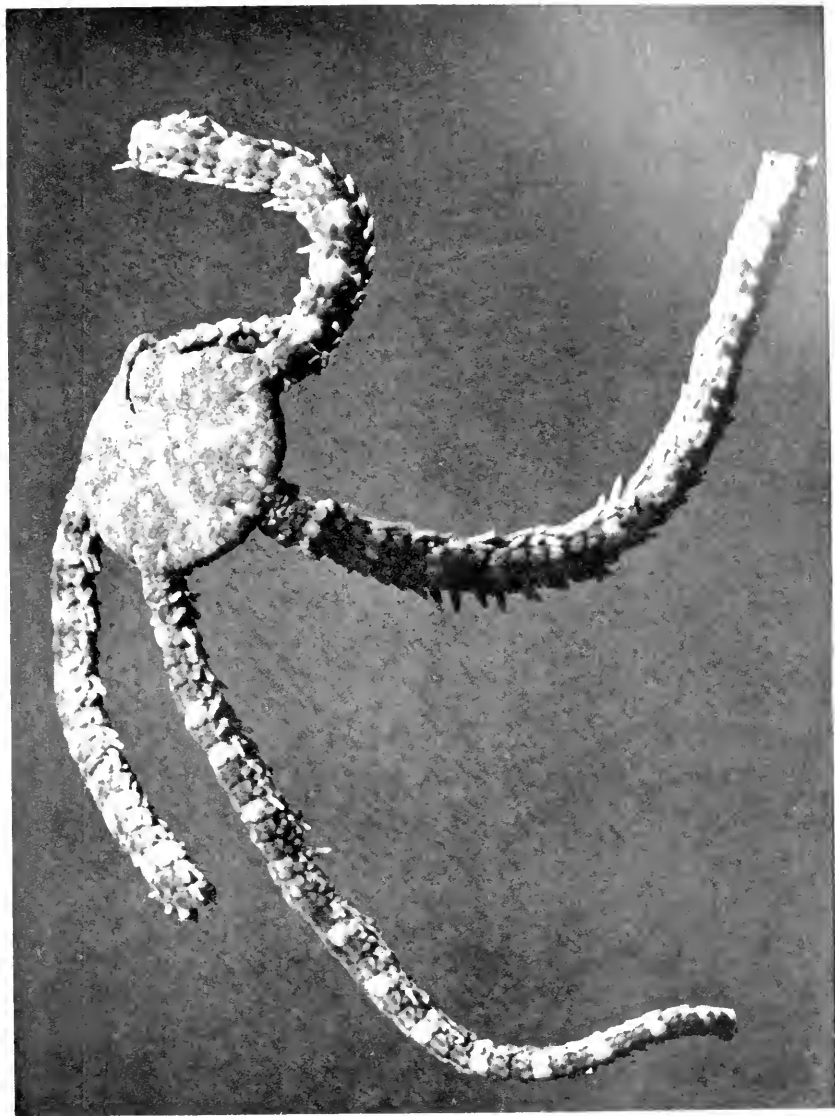
Genus: AMPHOIDIA Verrill

Amphiodia ochroleuca (Brock)

✓

Plates 42 and 43

TYPE: Mr. Brock founded this species on a single specimen from Amboina, deposited in the Gottingen Museum.



Amphiodia ochroleuca (Brock), $\times 3$, from Ingham Island, Queensland.



Amphiodia ochroleuca (Brock), $\times 3$, from Ingham Island, Queensland.

DISTRIBUTION: This species is apparently quite rare, the type locality being the only published record of its occurrence. The "Alva" specimen from Ingham Island, Queensland, substantially extends the southern range of this species.

MATERIAL EXAMINED: Three specimens, taken from coral, Ingham Island, Queensland, October 12, 1931.

TECHNICAL DESCRIPTION: The disk diameter is 5 millimeters; the arm is 21 millimeters long and is very tapered distally. The abactinal surface of the disk is of rounded-pentagonal contour and is paved with numerous small overlapping scales. In the center there is a rosette pattern composed of a small, circular, central elevated scale, surrounded by about seven of the low small scales, which in turn are surrounded by more small scales, which are interspersed between five separated elevated subcircular scales like the central scale and forming an interrupted circle around it. Beyond these five large scales there are in longitudinal series, one series on each brachial area, four similar coarse circular scales, the outer two of which lie between the radial plates. Interspersed among these and also covering the remainder of the abactinal surface, the side margins of the interbrachial areas and the interbrachial areas of the actinal surface is a pavement composed of small subcircular, semicircular and irregular overlapping scales. The paired radial plates are well separated, irregularly oval, with the long diameter not more than twice the short diameter, which is about equal to the center disk scale and also about equal to the width of the space between the two radial plates of a pair.

On the actinal surface the scales are more even, smaller, continuously overlapping and extend up close to the jaw angle. The genital slits are of moderate size. The central mouth plate is slightly longer than wide, with the inner angle acute, the others rounded. The side mouth shield is tapered to a very narrow apex inward, this reaching to about half-way the length of the inner half of the central plate and being produced to a wider externally rounded lobe where the side mouth shield touches the first ventral arm plate. The jaws are triangular, with six mouth papillae on each side, these are coarse, of irregular shape and blunt distally except the apical tooth, which is pointed.

The arms are from four and one-half to six times the length of the disk diameter. The dorsal arm plate is nearly triangular

with the lateral-distal margins convergent and rounded distally. This plate is situated mid-dorsally and overlapping on either side of it are the prominent side arm plates which project latero-dorsally and extend distally farther forward than does the related dorsal plate. The side arm plates each bear three short, stout, blunt spines which on the average have the ventral and dorsal spines subequal and the median one the longest and also thickest, being from one-fourth to one-third longer than the other two spines. The ventral plate is a little wider distally than long, with the distal margin widely rounded, the lateral margins concave beside the adjacent tentacle scale, and the inner margin of the plate appearing concave because of the overlapping adjacent plate. There are two tentacle scales, the larger one is a broad oval, widely rounded distally. The smaller scale is more tapered distally.

REFERENCES: *Amphiura ochroleuca*, BROCK, J., Zeit. f. Wiss. Zool., Leipzig, 1888, Bd. XLVII, p. 485.—KOEHLER, R., Mem. Soc. Zool., France, Paris, 1904, t. XVII, p. 63, figs. 12-13. (Figures original specimen of Brock.)

Amphiodia ochroleuca, CLARK, H. L., Mem. Mus. Comp. Zool., 1915, vol. XXV, p. 250, entry No. 659; Publ. 214, Carnegie Inst., Washington, Dept. Marine Biol., 1921, Vol. X, p. 107.

Genus: OPHIACTIS Lutken

Ophiactis brocki de Loriol

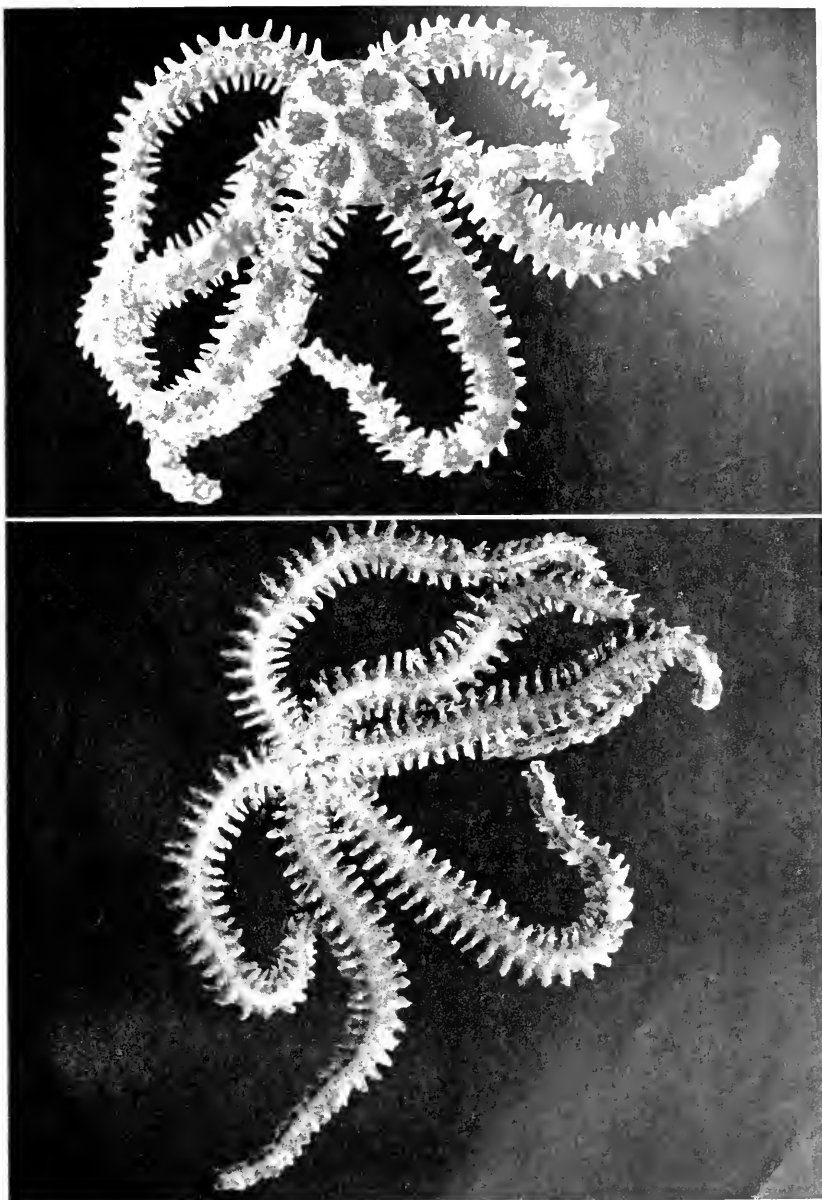
✓

Plate 44

TYPE: This was collected in Amboina Bay and is deposited in the G  neve Musee d'Histoire Naturelle.

DISTRIBUTION: The "Alva" specimens appear to be the first record of this exquisite species since the type and substantially extend the geographic range of this species in the tidal zone, it having been found abundantly in the Society Islands and also taken at Ingham Island, Australia.

MATERIAL EXAMINED: Seventeen specimens, Venus Point Reef, Tahiti, Society Islands, August 17, 1931. Two, on coral, Ingham Island, Queensland, Australia, October 12, 1931.



Ophiactis brocki de Loriol, $\times 4.5$, from Tahiti.

COLOUR: The present specimens, which have been preserved in alcohol for about five years, still have the radialia deep seaweed green, lightly maculated with cream as is the center of the disk, the remaining small plates are maculated with a (faded?) paler green and cream. The dorsal surface of the arms is transversely banded, having approximately every other plate dark green with the adjacent plates lighter green maculated with cream. The pattern in its entirety presents an indescribably beautiful mosaic in tones of green and cream.

TECHNICAL DESCRIPTION: Disk diameter 4 millimeters, arm length about 24 millimeters. Disk somewhat hexagonal with the abactinal surface nearly covered by the six pairs of radialia, each of which extend inward for three-fourths of the radius of the disk; the center is paved with numerous small irregular scales and similar scales cover the interrarial area and in a few instances occur in a single linear series between the inner lateral margins of the paired radialia. The radialia are long, narrow, each plate being subtriangulate with the apex directed centerward; the inner lateral margins lie side by side, or in certain instances are separated slightly on the inner half by a linear series of scales; the outer margin is produced to a rounded peak at the angle adjacent to the paired plate. The actinal surface has the interrarial portions covered with small scales similar to those of the abactinal surface.

The central mouth shield is small, but very little larger than the second under arm plate and is wider than deep, more heart-shaped than suboval with the inner apex subacute. The side mouth shields are somewhat triangular with the basal inner angle thickened and applied to the outer half of the lateral margin of the central plate, while the outer angle is more enlarged and rounded and touches the inner margin of the under arm plate, with the inner process of the side arm plate narrowed and applied to the inner side margin of the central plate, with the inner ends meeting. The mouth frame has the two halves separated proximally by a median cavity, but with the inner half with the adjacent margins meeting and distally supporting a large squarish tooth. There are two smaller, well separated, squarish, mouth papillae on each side of the mouth frame.

There are consistently six arms present in each of the eighteen specimens. The dorsal arm plate is wider than long, with the

outer margin undulate-convex, the lateral margins oblique and the inner margin narrower than the outer. Farther down on the arm, these plates appear to be nearly oval. The side arm plate overlaps dorsally on either side of the base of the dorsal arm plate, laterally supports six short spines that increase in length from ventral to dorsal (see plate 44), and ventrally margins the under arm plate. The four most ventral spines are finely serrulate, as figured; the fifth and sixth spines are thicker, longer and usually not serrulate. There is one tentacle scale present; this is a large oval, one-half as wide as long, being as long as and adjacent to the lateral margin of the octagonal ventral plate. The ventral arm plate is lozenge shape, each plate being a not quite equal-sided octagon. The external surface of the plates is finely granulose.

REFERENCES: *Ophiactis brocki*, DE LORIO, P., Revue Suisse de Zool., 1893, t. I, p. 401, pl. 14, figs. 1-a, e.—CLARK, H. L., Mem. Mus. Comp. Zool., 1915, vol. XXV, p. 266, entry No. 775.

Ophiactis savignyi (Muller and Troschel)

✓

Plate 45

TYPE: Savigny published the first record of this species in the exquisite figures given on plate 2, figures 4 and 5, Echinodermes, Descripte de Egypte, 1809. His specimens were deposited in the Paris Museum. Muller and Troschel gave the first text description of this species, which was apparently based on the Paris Museum material, which was collected in Egypt.

DISTRIBUTION: This exquisite small tropicopolitan species, originally reported from Egypt (1809), has since been recorded from numerous stations in the littoral zone of the tropic Atlantic, Indian and Pacific Oceans, as follows: Egypt (Ljungman), Red Sea (Risso); Zanzibar (Lyman, H. L. Clark); Indian Ocean, Mauritius (Ljungman, H. L. Clark); Ceylon (H. L. Clark); Nicobars (Lutken); Singapore (von Martens, H. L. Clark), Batjan, Java (von Martens); Dutch East Indies at twelve "Siboga" stations: Java Reefs, Timor, Kwandang Bay, Gebe Isle, Saleyer, Aru Isles,



Ophiactis savignyi (Muller and Troschel), $\times 4.5$, from Raiatea Island.

Bawaen Isles, Amboina (Koehler); China Sea (von Martens), Korean Seas (Duncan); Japan: Kajiro, Misaki (Matsumoto); Philippine Islands: Samboanga, 10 fathoms (Lyman); Gebu, Bantayan Reef (H. L. Clark); Pelew Island, Torres Strait: Badu, Thursday Island, Friday Island, Erub, Murray Island, Mer (H. L. Clark); eight stations in Shark's Bay, southwest Australia (Koehler); Viwa, Fiji Islands (H. L. Clark); Samoa, Tonga Islands; Society Islands (Ljungman); Tahiti (Lutken); Society Islands (H. L. Clark); Sandwich Islands (Grube, Lyman); Oahu and Pearl Harbor, Hawaiian Islands (H. L. Clark); Honolulu (Lutken); San Diego, California (H. L. Clark); Cape St. Luca, Lower California (Verrill, J., H. L. Clark); Mazatlan, Mexico, (H. L. Clark); Acapulco, West Mexico (Lutken and Mortensen); Punta Arenas and Realejo, Costa Rica (Lutken, Verrill); West Central America (Lutken); Pearl Islands, Panama (Verrill, H. L. Clark).

The Atlantic Ocean records are: Carolina (Ljungman); common from Charleston, South Carolina, and the Florida Reefs to Abrolhos Reefs, Brazil (Verrill); Miami, Florida (H. L. Clark, Boone); Pigeon Key Lake, Key West and Dry Tortugas, Florida, (Koehler), Key West and west of Tortugas, 37 fathoms, Cape Florida and Flannegan's Passage, 27 fathoms (H. L. Clark); Bermuda (Verrill, Koehler); Harrington Sound, Bermuda, (H. L. Clark); Spanish Wells, Eleuthera Island, Bahamas (Koehler); Bahama Banks (Verrill); Bahamas, also Santa Cruz (? Cuba), Porto Rico, Jamaica; Montego Bay, Port Henderson and Port Royal (H. L. Clark); "Albatross" stations 2374 and 2409 and "Fish Hawk" station 7293, in West Indian waters (Koehler); Saint Croix and Saint Thomas, Virgin Islands (Lutken, H. L. Clark, Koehler); Rio de Janeiro (Verrill); Brazil and Abrolhos Islands (Koehler); coast of Brazil (Ludwig).

MATERIAL EXAMINED: Three specimens from Teviatoa Reef, Raiatea Island, Society Islands, August, 1931; sixty-eight specimens, entwined in a hydroid colony, *Corydendrium splendidum* Boone, taken at low tide in one fathom, Kaneohe Bay, Oahu, Hawaii, December 28, 1928, by the "Ara."

REMARKS: These fascinating small, green and white serpent-stars were so intricately entwined within the hydroid colony, *Corydendrium splendidum* Boone (new species, loc. cit., p. 33, pl.

4), itself a cluster of green and white feathery fronds, as to be invisible, the small serpent-star disks very closely resembling the globular female gonotheca of the hydroid, and the serpent-star arms intertwined among the branching hydroid fronds. The smallest of these ophiurans have a disk diameter of about 2 millimeters and the largest ones are from 3 to 4 millimeters diameter. All are regularly six-armed.

Delicately entwined among the arms of a serpent-star and hydroid frond, and so closely resembling the ophiuran arm as to be mistaken for it, there was found a *Polychaete* Annelid, the metameric segmentation and parapodia effecting perfect mimicry of the joints of the brittle-star arm and arm-spines.

TECHNICAL DESCRIPTION: The largest of the three specimens from Raiatea Island has the disk diameter of 4 millimeters and an arm length of about 16 millimeters. The disk is circular, moderately thick and has the greater portion of its surface covered with six pairs of large, cordate radial plates, the apices of which are directed inward and reach nearly two-thirds of the radius of the disk. The plates of a pair of radialia are each pear-seed shape, stout, adjacent proximally and with the inner tapered third a little separated by a row of small scales. The outer lateral margin of the radial plate is more rounded than the inner margin, and the distal or outer margin is sinuate, being produced to a rounded peak on the inner half. The center of the disk, interradian areas and lateral margins are paved with small, suboval, subcircular and irregular scales. The circumferal margin of the disk is beset with coarse, stout, conical spines, set well apart and having their tips beset with small hooks. Less frequently these spines occur near the center, along the median radius line of the interbrachial area and along the outer margin of the radial plates and at or almost on the apices of the radial plates. The actinal surface of the disk is paved with small scales similar to those of the abactinal surface.

The central mouth shield is wide suboval, with the outer margin widely convex and the inner margins oblique, converging to a subacute apex. The adoral shields are triangular, with the narrowed apices meeting within, the inner distal angle adjacent to central plate and the outer distal angle rounded and touching the minute first under arm plate. There are two, more rarely three, small, squarish mouth papillae on either side of the jaw

frame, set well apart from one another, on the inner half of the jaw frame.

The first under arm plate is minute and in contact with the outer angle of the adoral plate. A typical under arm plate is hexagonal, longer than wide, with the outer margin widely convex, the inner margin very narrow, and the lateral margins each consisting of a short oblique proximal part and the longer concave portion adjacent to the tentacle pore. There is one tentacle scale, which forms a wide oval.

The side arm plates each support six or seven short, thick, blunt, rough arm spines, which are conical. One specimen has only five to six arm spines, but otherwise agrees with the typical *savignyi*.

The upper arm plate is nearly twice as wide as long, with the outer margin widely convex-sinuate, the dorsal surface continuous reticulate with small, circular granules.

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Family: OPHIOTRICHIDAE

Genus: OPHIOTRICH Muller and Troschel

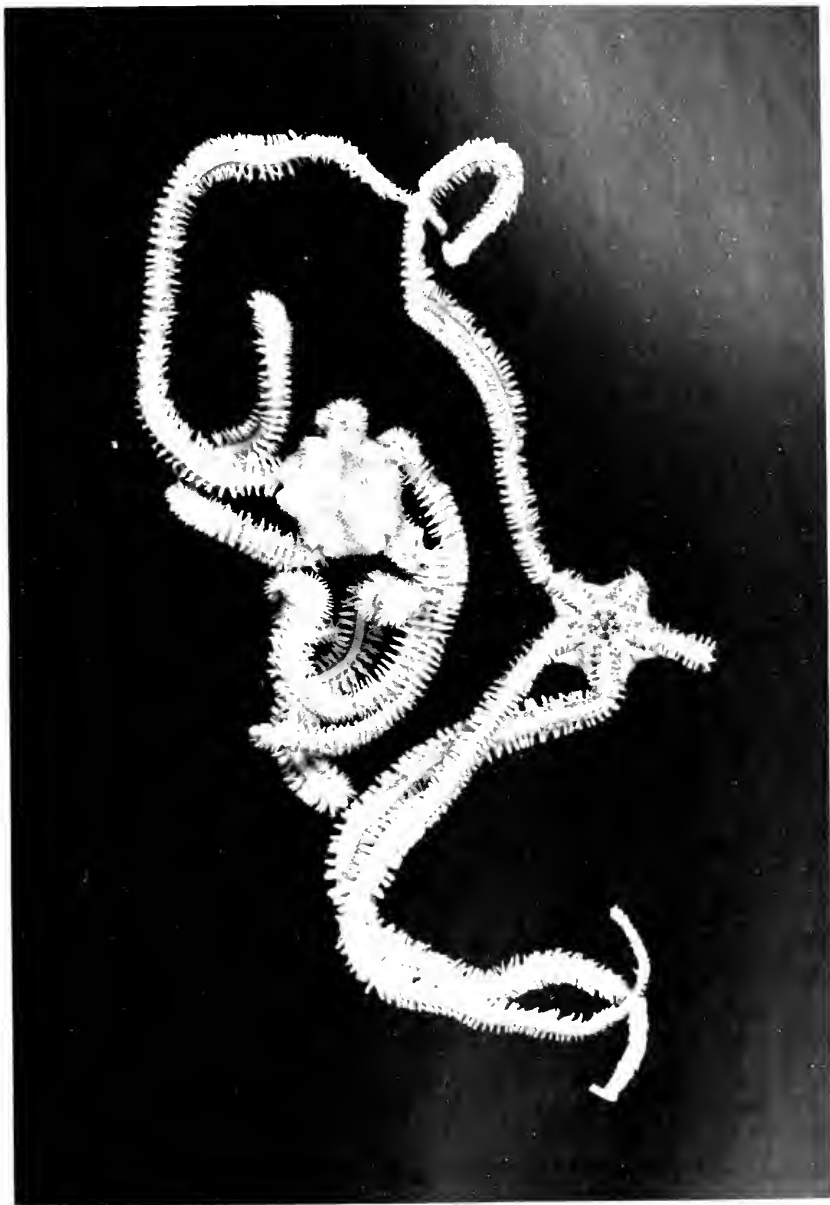
Ophiotrich expedita Koehler

1

Plate 46

TYPE: The "Siboga" discovered the species at ten stations in the Dutch East Indies, represented by fifteen specimens and a fragment, which are deposited in the Leyden Museum.

DISTRIBUTION: Pidjot Bay, Lombok Isle, 22 meters; anchorage, Pulu Kawassang, Paternoster Isles, 12 meters; Sapeh Straits,



Ophiothrix expedita Koehler, $\times 2$, from off Anambas Islands,
South China Sea, 30 fathoms.

69 meters; Tawi Tawi Islands, Sulu Archipelago, 12 meters; Pearl Bank, Sulu Archipelago, 15 meters; Pulu Tongkil, Sulu Archipelago, 13 meters; Great Sangir Island, 45 meters; Gebe Isle, 31 meters; anchorage, south of Timor, 34 meters; Rotti Isle, 34 meters; Station 310, 8° 30' S., 119° 7.5' E., 73 meters ("Siboga" Stations, Koehler); Sulu Archipelago: near Siasi and also near Tawi Tawi Islands, three specimens ("Albatross"); Anamba Bay, Malay Straits, "Ara" Station (Boone).

MATERIAL EXAMINED: Four specimens in excellent condition, taken in 30 fathoms, at Anambas Isle, Lat. 3° N., Long. 106° East, eight miles west of Terampa Cove, Siantan Island (in the Malay Straits, northeast of Singapore), by the "Ara."

This species appears to have its center of distribution in the Dutch East Indies-Philippines area, the "Ara" specimens from the Anambas Islands adding another locality for it in the Malay Straits.

TECHNICAL DESCRIPTION: The disk is pentagonal to subcircular in outline, diameter, 7.5 millimeters; arm length, about 70 millimeters. The entire abactinal surface, except the paired radial plates, is covered with numerous upright conical spines from 0.8 to 0.5 millimeters high, which occur from 0.5 to 1.0 millimeter apart, of irregular sizes and irregularly spaced, these spines averaging a greater height near the circumference of the disk and becoming increasingly more numerous, smaller and sharper near the center. Similar spines occur on the circumferal margin and on the interbrachial region of the actinal surface where they are very numerous and acuminate. These disk spines are of two types: (a) the conical acuminate spines with the spinulose lateral margins and two or three spines clustered at the apex; and (b) club-spines, which are thicker, cylindrical with thickened spinulose apices and with spinules also on the lateral margins. The radial plates are covered but show an elongate, narrowed pear-seed shape, extending inward two-thirds of the radius of the disk, with the outer margins the wider, truncated, with a rounded inner angle; the inner lateral margins are relatively straight, well separated, except at the inner lateral angles, diverging obliquely from these angles to the apices, which are separated from each other by a distance equal to the width of the outer margin of one plate; the region between these plates bearing a double series of coarse upright spines, like those on the remainder of the abactinal sur-

face. The central mouth shield is widely cordate with the apex directed outward, rounded. The side mouth shields are small, triangulate, well separated at their inner angles, where each supports a strong, conical tooth. The vertical oval contains numerous small denticles, closely crowded.

The five arms are very long, about ten times or more the disk diameter, slender and very flexible. The dorsal arm plate is trapezoidal, being narrow and nearly straight on the proximal margin with the lateral margins obliquely divergent and the lateral angles rounded, the distal margin widely rounded, forming a continuous convexity; the length of the plate being nearly a third greater than its width.

The side arm plates are wide and support on the proximal joints ten arm spines which soon decrease to eight farther down the arm, which form a comb-like series, the ventral six, or four spines, being the longest of the series, these decreasing in length from the most ventral toward the dorsal, while the dorsal four spines are noticeably much shorter than those preceding and likewise decrease in length dorsad. The apices of the ventral four arm spines are each produced into a claw-like procurved tooth or spine distally, which is directed ventrad in almost every instance. The arm spines are stout, laterally compressed and under magnification show a continuous series of fine spinules or rugosities arranged in longitudinal series on the side of the spines, with a terminal cluster of coarser sharp spines which on the longer arm spines not infrequently are developed as procurved hooks. The narrowed lateral margins of the arm spines are also beset with irregular rough spinules.

The under arm plates are with the angles rounded, the lateral margins reenteringly curved and the distal margin slightly concave. The single tentacle pore is large.

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Ophiothrix longipeda (Lamarck), $\times 1$, from Seba-Seba Bay,
Durian Straits, Dutch East Indies, 14 fathoms.

Ophiothrix longipeda (Lamarck)

1

Plate 47

TYPE: Lamarck's type was secured in the Indian Ocean, in the vicinity of Ile de France (Mauritius), and is deposited in the Paris Museum.

DISTRIBUTION: This species is known in the littoral zone from the Red Sea eastward through the Persian Gulf and the Indo-Pacific northward to Japan, southward to southwest Australia and eastward to the Society Islands. It is also known on the east African coast from the Red Sea southward to Madagascar and Natal. The following records for *O. longipeda* have been published: Red Sea (Ljungman); Zanzibar (Lyman, Ludwig, Koehler); East Africa (von Martens); Madagascar (Hoffman); Natal (H. L. Clark); Mauritius (de Blainville, Lamarck, Michelin, de Loriol, Mobius, H. L. Clark); as Ile de France (Muller and Troschel); Seychelles (Koehler); Persian Gulf (H. L. Clark); Tuticorin, Madras (Bell); Nicobars (Lutken, von Martens); Andaman Islands (Alcock, Koehler); Singapore (von Martens); Tonkin (Koehler); Japan: Ousima (H. L. Clark); Kominoto, Boshu, which is the northern Japanese limit, also at Tanabe Bay, Kii, Japan (Matsumoto); Philippine Islands: Samboanga (Lyman), Zamboanga, Mindanao (von Martens); Cebu, Bantayan Reef (H. L. Clark); numerous Philippine stations of the United States Bureau of Fisheries Steamer "Albatross" (Koehler); seven Dutch East Indies stations of the "Siboga," including Borneo Bank to Taruna Bay, Salawatti coast, New Guinea, Pulu Barang and Amboina Bank (Koehler); Amboina Bay (de Loriol); Amboina (Doderlein, Brock, H. L. Clark); Timor (Muller and Troschel, Herklots, von Martens); Java (Brock, H. L. Clark); Ternate (Lyman); Pelew Islands (H. L. Clark); Aru Islands (Koehler); New Guinea: Sorong (H. L. Clark); Thursday Island (Doderlein); Thursday Island and Port Molle (Bell); Torres Straits: near Cape York, Badu, Friday Island, Erub, Mer and Murray Islands, Queensland, near Cooktown, Green Island, near Cairnes, Port Curtis, Queensland (H. L. Clark); Turtle Island, Port Medland, Abrolhos Islands, all in southwest Australia (Koehler); New Caledonia

(Koehler); Fiji Islands (Ljungman); Fiji Islands, near Suva (H. L. Clark); Ebon, Marshall Islands (H. L. Clark); Samoa (Lyman, Clark); Tonga Islands: Tongatabu (Lyman); Hopai (Studer); Society Islands (Ljungman, Lyman); Papeete, Society Islands (H. L. Clark).

MATERIAL EXAMINED: Two specimens, broken, brought up on the "Alva's" anchor-chain, in Seba-Bay, South Brother's Island, Durian Straits, Dutch East Indies, 22 fathoms, October 21, 1931.

TECHNICAL DESCRIPTION: The "Alva" specimen has the disk diameter 20 millimeters; the arm length is 330 millimeters. The abactinal surface of the disk has the interr radial areas large, each being as wide at the narrowest point between the radialia as the greatest width of one radial plate; this interr radial area being three approximate series of long spinules, this area widens toward the circumference of the disk and here the long spinules are equally numerous. The interr radial areas converge toward the center like the spokes in a wheel, this center being equally beset with spines. The radial shields are five-sevenths as long as the radius of the disk and are triangular, placed side by side, being separated by only a linear area of skin which is slightly the wider on the inner half of its length and bears here two to three long spines; otherwise the shields are naked except for the encasing skin. Each shield is triangular with the apex directed inward; the outer margin is oblique, terminating in a rounded node at the inner side of the pair. The actinal surface has the interbrachial region covered with a tough integument and bears numerous spines similar to those of the abactinal surface, but progressively decreasing in length from the disk circumference toward the mouth where they are reduced to small denticles. The long disk spines are somewhat primitively fluted longitudinally with four to six ridges, the tips being flattish, the adjacent third of the lateral margins and tip being serrulate with four to eight coarse sharp teeth. The long abactinal disk spines are 2 millimeters long; the actinal spines are 0.8 to 1 millimeter long with the tips only serrulate. The genital slit extends two-thirds of the length from the mouth shield towards the circumference of the disk. The mouth shield is widely oval, the width being nearly one and a half times the length, with the outer margin widely convex, the inner margins produced to a median subacute apex.

The side mouth shields are each a long, narrowed triangle, with the narrowed ends meeting within. The mouth frame is typical *Ophiothrix*. There are six small, acute teeth clustered in the uppermost series at the apex.

The ventral arm plate is nearly rectangular, being slightly wider than long, broadly in contact through almost the entire width. There is one tentacle scale present, extending about one-half of the length of the lateral margin of the under arm plate and situated anterior to the first and second arm-spines. The tentacle scale is of medium size, narrowly oval, with pointed or narrowed rounded apex. The tube foot has the surface beset with numerous coarse, spiny granules.

The side arm plates support near the base of the arm seven, and farther along the arm, six arm spines in series. These spines increase in length from the ventral to the sixth spine, the seventh or most dorsal spine, when present, being shorter than the sixth spine. The first, second and third spines are short, the fourth spine medium, the fifth and sixth spines long, the seventh slightly shorter and weaker than the sixth spine. The first, second and third spines are each about one-third longer than its predecessor, the fourth spine being nearly twice as long as the third, while the fifth spine is one and two-thirds times as long as the fourth and the sixth spine is twice as long as the fourth spine. The first, second and third spines are very compressed, with the distal portions spatulate and the lateral margins coarsely serrulate; the fourth to sixth (or seventh) are more convex, with the distal third of the lateral and terminal margins spatulate and serrulate with a longitudinal series of fine sharp granules.

The dorsal arm plates are wider than long, the length being a little less than the width of the inner margin, or equal to about one-half of the width of the widely rounded outer margin. The lateral margins are oblique.

COLOUR: See H. L. Clark, plate 15, figure 5.

The present specimens, alcohol-preserved for several years, have the disk spotted violaceous purple and the arms transversely banded alternately with purple and cream.

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Ophiothrix striolata Grube

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TYPE: Grube's type was obtained in the China Seas and is deposited in the Breslau Zoological Museum.

DISTRIBUTION: This species appears to have its center of distribution in the Dutch East Indies, having been recorded from the Mergui Archipelago, in the eastern Bay of Bengal, northward to the China Sea and eastward through the Sunda Islands and down to Thursday Island. The following stations for it have been published: China Sea (Grube); Philippine Islands, "Challenger" station 208, off Panay, 18 fathoms, also Samboanga, 10 fathoms (Lyman), numerous "Albatross" stations in the Philippines, in the Sulu Sea, off Balabac and off Cebu, in depths from 10 to 44 fathoms (Koehler); Mergui Archipelago, Sunda Archipelago, Gulf of Siam (Koehler); Thursday Island, Queensland, north of Cape York (Bell, Doderlein, Koehler); Freemantle and Cockburn Sound, Port Royal, southwest Australia (Koehler).

MATERIAL EXAMINED: The arms, minus the disk, of a specimen brought up on the anchor chain, in Seba-Seba Bay, South Brother's Island, Durian Straits, depth 22 fathoms, October 21, 1931.

DISCUSSION: The arm plates and arm spines of the present imperfect specimen, also the colour pattern, conform with Grube's

description of this species and with the excellent figures given by Doderlein and Koehler.

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Genus: *OPHIOCNEMIS* Muller and Troschel

Ophiocnemis marmorata (Lamarck)

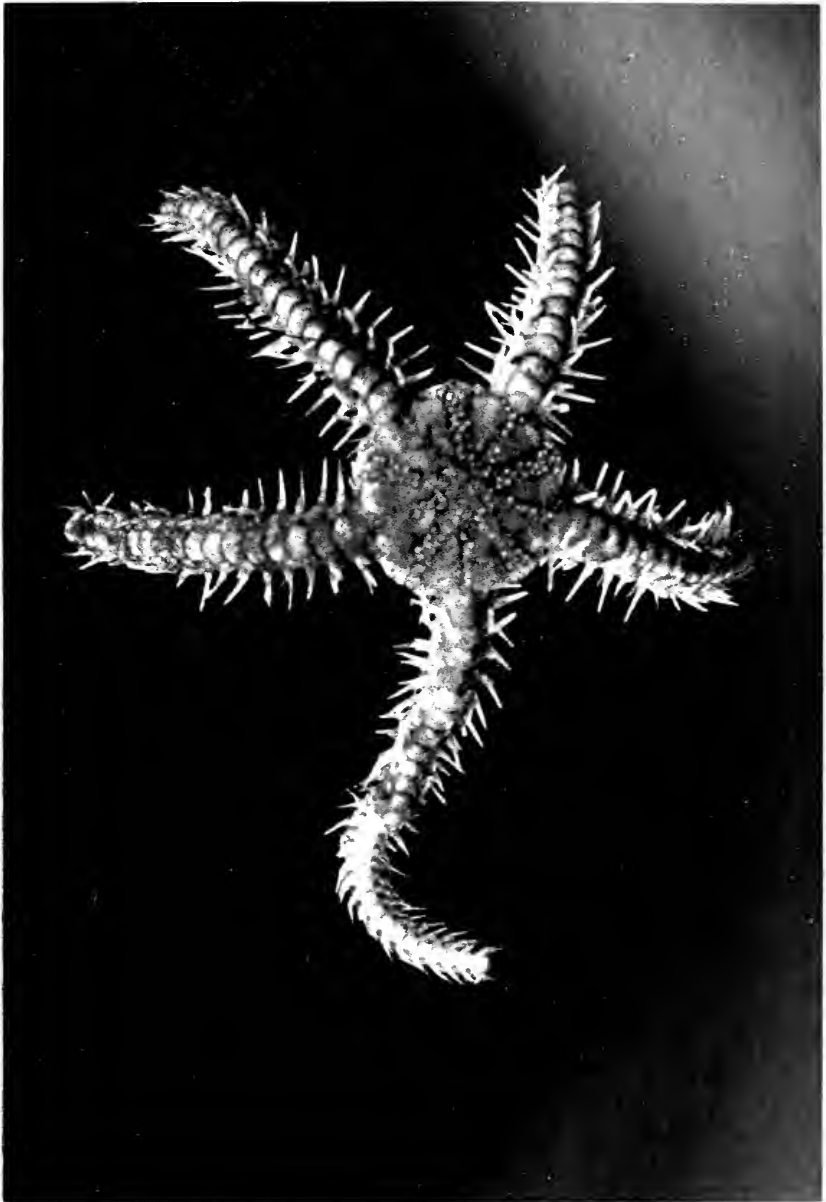
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Plates 48 and 49

TYPE: Lamarck's type, now deposited in the Paris Museum, was listed by him as "Habite . . . des voyages de Peron et Leseuer." (Voyages de de'couvertes aux Terres Australis, execute . . . pendant 1800-04, et redige par M. F. Peron, 1807-16).

DISTRIBUTION: This species is widely distributed over the entire littoral zone of the Indo-Pacific, having been recorded from Zanzibar and the Cape of Good Hope, South Africa eastward in the Mergui Archipelago, Ceylon, Singapore, the Philippines between Panay and Guimaras, 37 fathoms, the Sunda Archipelago and on the coast of northwestern Australia.

MATERIAL EXAMINED: One specimen, brought up from a depth of 14 fathoms, in Durian Straits, south entrance to South Brother's Island, Dutch East Indies, October 22, 1931.



Ophiocnemis marmorata (Lamarck), $\times 3$, from Durian Straits,
Dutch East Indies, 14 fathoms.





Ophiocnemis marmorata (Lamarck). $\times 3$, from Durian Straits,
Dutch East Indies, 14 fathoms.

TECHNICAL DESCRIPTION: The disk is circular, diameter 5 millimeters. The abactinal surface has an exceptionally beautiful design, the five pairs of radial plates being very regular and covering the greater part of the surface. Each plate is subtriangulate, with the outer margins quite convex and the lateral margins convergent to a pointed apex that extends inward three-fourths of the radius of the disk. The surface of the plate is microscopically granulated. The plates of a pair are separated from each other by a row of flat, hexagonal and pentagonal scales. Each scale supports in its center a large, thick, convex tubercle, distally serrulate. The center of the disk is paved with nine to twelve of these irregularly arranged hexagonal and pentagonal scales from which the tubercles have been broken off. Radiating from this center are the five bands of scales arranged in single series, extending one each between the paired radialia. Also branching out from this center, like the spokes of a wheel, are the interrarial areas, each of which is as large dorsally as one radial plate and on the circumferal margin appears to be a little wider than the plate, since the interrarial area is continuous with the related circumferal margin below the plate. Each interrarial area is about two small scales wide at the center and six or seven scales wide at the circumference. The scales, paving the interrarial and circumferal areas without exception, bear each a large convex, distally serrulate tubercle, or bead.

The actinal surface is paved with scales similar to those of the abactinal center but devoid of tubercles below the circumferal area. The genital slit is relatively large, extending from almost the outer margin of the center mouth plate nearly to the circumferal margin. The mouth shield is small, widely suboval, with the inner margin produced to a median small point and also with the inner distal margin adjacent to the margin of the tentacle pore of the second under arm plate; the remaining lateral and outer margins of the central plate are widely rounded. The side mouth plates are large, somewhat rectangular with the angles rounded, the inner margins meeting. The outer lateral margin is adjacent to the lateral margin of the small first under arm plate, also the inner angle of the second arm plate. There are ten tentacles, two each inside of each small first arm plate. Each jaw angle consists of two small plates separated internally by a narrow slit, but fused at the apex, where it supports two strong,

narrow, tooth papillae. There are fifteen to sixteen tooth papillae in each oval.

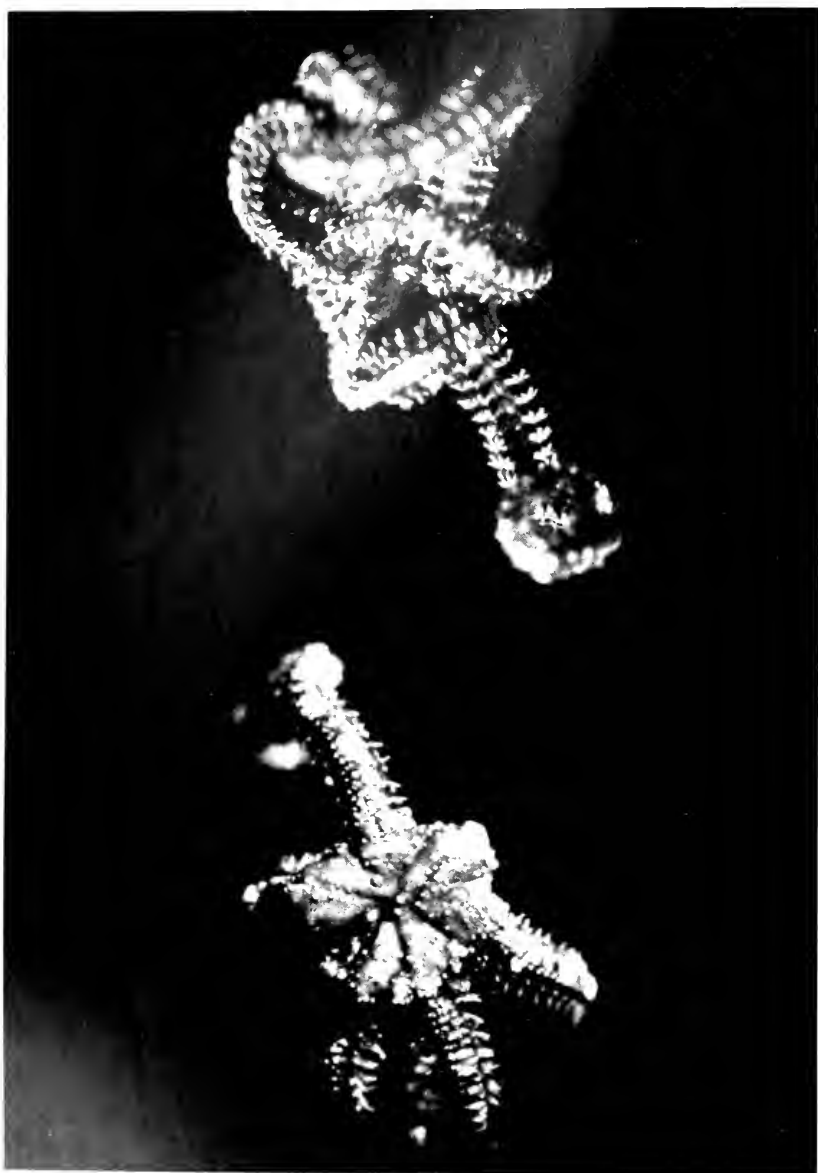
The first under arm plate is much smaller and of somewhat different shape than the others. It is pentagonal with the two inner margins concave, convergent to a median apex, the side margins are moderately concave, adjacent to the angle of the side mouth plate; the outer margin is nearly straight. The second under arm plate is one and one-half times as long as the first and has the inner and outer margins subparallel, straight, the outer one being the longer; the lateral margins are quite concave. The third and succeeding arm plates are similar, the width being 1.6 times the length, each plate having the form of a subrectangle, with the angles briefly rounded. There is one very large tentacle pore present and but one scale which is small, oval, distally acute.

Near the disk, on some arms, the first one or two side arm plates each bear four instead of three large arm spines; farther down each side plate bears three conical spines, the median of which is the longest, being twenty percentum longer than the upper spine and fifty percentum longer than the ventral spine. Under magnification the spines are coarsely granulose, spinose, especially along the lateral distal margin. Ventral to and in line with the third spine is the true first ventral arm spine transposed into a hook; the peduncle is enlarged and bears a small scimitar-like blade, which proximally on the concave side has two sharp teeth and distally a curved blade. These hooks appear to increase in size on the distal portion of the arm. Some have the second hook nearly as large as the first.

The dorsal arm plates are arched, having a median ridge longitudinally. The inner and outer margins of each plate are subparallel, the inner one being the shorter, while the lateral borders are oblique. These plates are twice as wide on the distal margin as long, and the proximal margin is 0.8 as wide as the distal.

REFERENCES: *Ophiura marmorata*, LAMARCK, J. B., Anim. sans Vert., 1816, t. II, p. 543.

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Ophiothela danae Verrill, $\times 3$, on sea-urchin, *Prionocidaris baculosa*
var. *annulifera* Lamarck, from Seba-Seba Bay,
Dutch East Indies.

Jahrb. Bd. III, p. 833, pl. 31, figs. 6a-c.—KOEHLER, R., Bull. Scientif. France-Belg., 1898, t. XXXI, p. 84.—LUDWIG, H. Abh. Senckenberg. Naturf. Gesell., 1899, Bd. XXI, p. 550.—LORIOU, P. DE, Revue de Suisse Zool., 1900, t. VIII, p. 84.—LYMAN, TH., Rept. Sci. Res. H. M. S. "Challenger" Zool., vol. V, 1882, Ophiuroidea, pp. 229, 312, 326, pl. 42, figs. 14-15.—KOEHLER, R., Siboga-Expeditie, Ophiures Littorales, II, Monogr. XLV, pt. II, 1905, p. 112; Bull. Sci. France-Belg., 1907, t. XLIV, p. 166.—CLARK, H. L., Mem. Mus. Comp. Zool., 1915, vol. XXV, p. 283; Spolia Zeylanica, 1915, vol. X, pt. 37, p. 90.—KOEHLER, R., Bull. 100, vol. U. S. Nat. Mus., 1922, p. 296.

Genus: OPHIOTHELA Verrill

Ophiothela danae Verrill

1

Plate 50

TYPE: The type series was secured in the Fiji Islands, in large numbers, on *Melitodes virgata* Verrill (*Melitodes ochracea* Dana), by Prof. J. D. Dana, of the United States Exploring Expedition. The depository is not stated, but a part of the material is in the Museum of Comparative Zoology, Cambridge, Mass., and a part very probably is in the Philadelphia Academy of Sciences.

DISTRIBUTION: This remarkable little Ophiuroid, most frequently found commensal in corals, or on the spines of echinoids, has a wide geographical distribution. Bathymetrically, it is known from the shore line down to 100 fathoms. It has been recorded from the Arabian coast of the Red Sea (Koehler), eastward to Puri, Orissa, India, on the Bay of Bengal, 10 fathoms, (Koehler) and at Singapore (Turneretscher), northward in the Formosa Straits (Lutken, Lyman), and the Korean Seas (Duncan), and numerous specimens clinging to *Melitodes* sp., Moroiso, Misaki, in 5 to 10 fathoms and more from off Misaki, Japan, which appears to be the northernmost record for *O. danae* (Matsumoto). Southward it is known from the Philippines between Burias and Luzon and at four other "Albatross" stations in the Sulu Sea, in depths from 18 to 24 fathoms and also from numerous "Siboga"

stations in the Dutch East Indies: Bima; Badjo Bay; Flores; Laiwui, Great Obi Island; the coasts of Salawatti; Gisser; Kur Island; Kei Islands: Aru Islands, Kulewatti, Dammer Island; Banda; Amboina (Koehler), also Badjo Bay, Flores Island, 23 fathoms (H. L. Clark) and Durian Straits (Boone); Amboina (Doderlein). Southeastward from the Red Sea this species is found at Mauritius (Brock) and west Australia: Shark's Bay, Albany, Oyster Harbor, (Koehler) which appears to be the southernmost record of the species to date, and eastward to the Fiji Archipelago, the type locality (Verrill, Lyman, Clark).

MATERIAL EXAMINED: Three fine specimens, entwined on the primary spines of two specimens of *Prionocidaris baculosa* variety *annulifera* (Lamarck), brought up on the anchor chain of the yacht "Alva," in Seba-Seba Bay, South Brother's Island, Durian Straits, Dutch East Indies, October, 1931.

TECHNICAL DESCRIPTION: The diameter of the disk is 4.7 millimeters. The disk is subcircular, with the margin undulating; the abactinal surface is almost entirely covered by six pairs of large radialia, which are pear-seed-shape and have the two plates of each pair lying side by side, with the apices acute, directed inward and extending practically to the disk center; the distal margins are evenly rounded. The interrarial area is greatly reduced, the width of one section at the outer margin being equal to about one-half the width of one adjacent radial plate and tapering inwardly to a mere line at the apex. The entire abactinal surface is encased in a tough integument, which under high magnification shows a continuous pattern of low circular reticulations. In addition to these there are numerous coarse, irregularly scattered, well spaced, upstanding, blunt, thick, conical spinules or tubercles. At, or adjacent to, the apex of each pair of radialia there is one such spine which is twice as high and thick as the remainder. The spines are also similarly placed on the interrarial areas and near the circumference of the disk they become more conspicuous. These spinules are also very numerous at the base of each arm where they appear to be set in approximate rows.

The actinal surface has the interrarial areas encased in a tough skin which also covers the mouth-parts, so that their true outlines are indistinguishable. The side mouth shields are approximately as large as the central shield with which they are closely fused. The visible contour of the central shield appears squarish

with rounded angles. There are ten to twelve teeth, small, bluntish, arranged in an oval.

There are six arms; these are short, proximally thick, distally tapered to a blunt tip. The dorsal surface of the arm is encased in tough integument like that of the disk, which entirely conceals the dorsal, side, and ventral arm plates. There are apparently two transverse rows of coarse, bead-like tubercles to each articulation of the arm, one series of tubercles being between and in line with the bases of the arm spines, and the second series of tubercles is about halfway between these and the first series of tubercles of the next joint.

Each side arm plate supports five spines, which are proximally encased in tough skin, appearing to arise from a common, projected, thick base, not unlike the palm of a hand, from which five short spines radiate. Of these, the dorsal spine is very short, as is also the ventral, fifth, spine. The second, or next to dorsal, spine is twice as long as the first spine; the third and fourth spines are subequal, each being slightly longer than the second. All five spines are conical with the sides filled with short, sharp spinules, which toward the apex become coarser, more acuminate and more numerous.

The ventral arm plates are of medium size, skin-encased and appear to be squarish, with the distal margin lightly rounded, the lateral margins slightly concave.

The tentacle scale is situated in advance of and nearly opposite the fifth or most ventral arm spine.

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- Ophiothela isidicola*, LUTKEN, CH., *Ovt. Kgl. Danske, Vidensk. Selsk. Forh.*, 1872, p. 92, pls. 1 and 2, figs. 4-a-4-g.—LYMAN, TH., "Challenger," 1882, vol. V, Ophiuroidea, p. 231.—BROCK, J., *Zeit. Wiss. Zool. Leipzig*, 1888, Bd. XLVI, p. 537.—LORIOU, P. DE, *Mem. Soc. Phys. d'Hist. Nat.*, 1894, t. XXXII, p. 52.—CLARK, H. L., *op. cit.*, 1915, p. 285, entry No. 947.
- Ophiothela verrilli*, DUNCAN, M., *Journ. Linn. Soc. London*, 1878, vol. XIV, p. 477, pl. 11, fig. 33.
- Ophiothela danae* variety *involuta*, KOEHLER, R., *loc. cit.*, 1898, p. 89.

Chilophiurida

Family: OPHIOCHITONIDAE

Genus: OPHIONEREIS Lutken

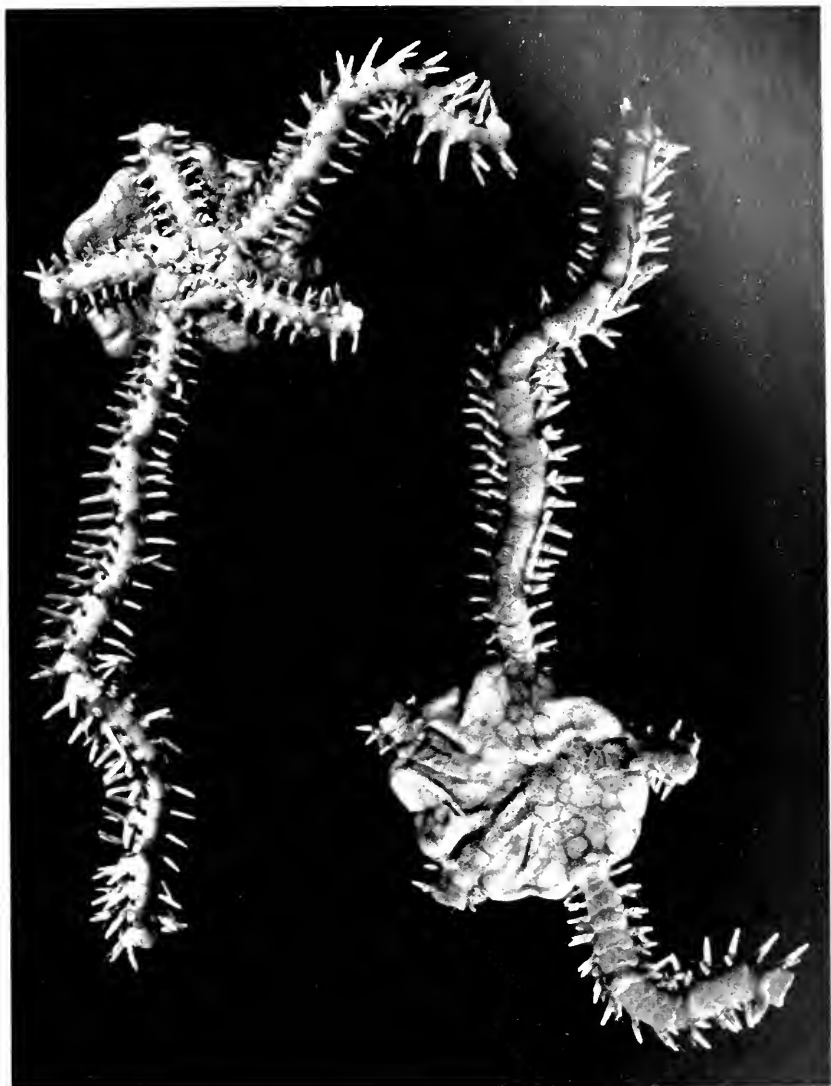
Ophionereis dubia Audouin and Savigny; Muller and Troschel

1

Plate 51

TYPE: Savigny and Audouin's type was collected in Egypt and deposited in the Paris Museum. Muller and Troschel amplified Audouin's exquisite figures of this species with a brief description, which was apparently based on his illustration.

DISTRIBUTION: This brittle-star is widely distributed in the Indo-Pacific, having been recorded from the Red Sea southward to Mombasa and Zanzibar, British East Africa, eastward to Mauritius, Torres Strait at Badu, Friday Island and Green Island near Cairnes, Queensland, also at Shark's Bay, southwest Australia, northward in the Sulu Archipelago at 10 fathoms and elsewhere in the Philippines at 30 fathoms and north to Japan, at the mouth of the Yeddo.



Ophionereis dubia Audouin and Savigny; Muller and Troschel, p. 325,
from Seba-Seba Bay, Dutch East Indies.

MATERIAL EXAMINED: One specimen, brought up on anchor chain, Seba-Seba Bay, South Brother's Island, Dutch East Indies, October 21, 1931.

TECHNICAL DESCRIPTION: Disk pentagonal, diameter 8 millimeters, arms each 67 millimeters long. Abactinal surface of disk paved with large to medium-size suboval, subcircular and other irregular polygon-shaped plates. These plates are smaller in the series extending inward from the arms, while the wide interbrachial areas are pouchlike, covered by much wider plates toward the circumference, frequently only two wide plates covering the entire outer upper border of an interbrachial area. The actinal surface is paved with plates similar to those of the abactinal, which on the actinal surface tend to decrease in size toward the center. The genital slits are smooth and large, extending from the angle of the mouth plate almost to the circumference of the disk. The mouth shield is small, nearly as wide as long, 0.9 millimeter wide, 1 millimeter long, heart-shaped with the apex directed inward. The side mouth shields are narrowed inwardly into large triangles placed wedge-like, one on either side of the central shield with the apices not meeting; the outer angle of each side mouth shield is widened into a rounded process that touches the first under arm plate. The mouth frame is subrectangular with the two halves meeting within. There are ten mouth papillae to each jaw angle, five on each side. These are short, thick, with the distal margin wide, blunt, slightly rounded. The apical tooth is large, blunt, squarish.

The under arm plate is axe-blade shape, about 0.8 millimeter long, and 0.6 millimeter greatest width, yet appearing almost squarish, with the distal margin definitely rounded, the lateral margins equally concave and the proximal margin actually nearly straight or slightly convex but appearing slightly concave because of the overlapping adjacent blade. There is only one tentacle scale which is oval, very large and broad, about 0.4 millimeter long and 0.2 millimeter wide. Each side arm plate supports three strong spines, of which the median is about one-fourth longer than the ventral which is about subequal to the dorsal spine. These spines are strong, tapered, blunt-tipped, laterally compressed, having two opposed sides definitely much wider than the remaining region. The arm spines are transversely banded with alternating dark brown and cream in the present alcohol-preserved specimen. The side arm plates extend well up on the dorsal sur-

face, margining either side of the dorsal arm plate, as figured. The dorsal arm plate is small, fan-shaped, with the distal margin convex but rather abruptly produced medially, the oblique lateral margins overlapped by the side arm plates and the proximal margin extremely narrow, overlapped by the adjacent plate.

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Ophionereis dubia variety *sinensis*, DUNCAN, MARTIN, Journ. Linn. Soc. Zool., London, 1875, vol. XIV, p. 464.

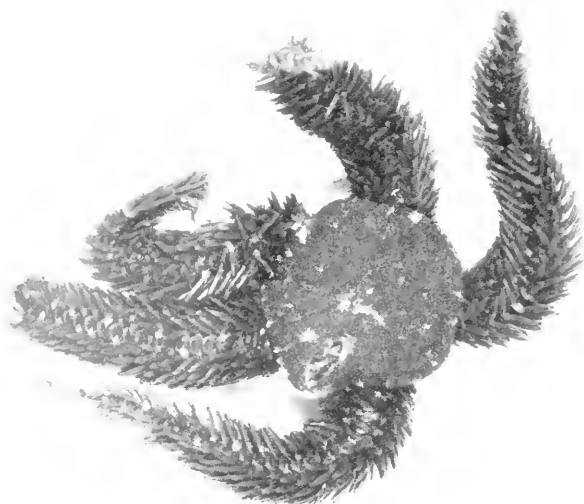
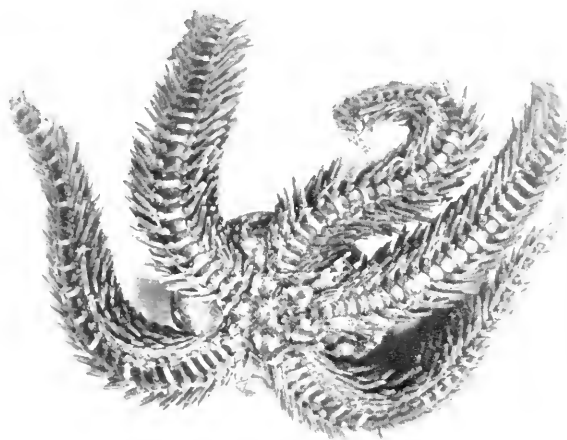
Family: OPHIOCOMIDAE

Genus: OPHIOCOMA L. Agassiz

Ophiocoma lineolata Muller and Troschel

Plate 52

TYPE: The type specimen of *Ophiocoma lineolata* was collected in the Ile de France and is deposited in the Paris Museum; the type of *O. pica* is also in this museum but is without the original locality.



Ophiocoma lineolata Muller and Troschel, $\times 1.5$, from Pearl Harbor,
Oahu, Hawaii.

DISTRIBUTION: This species is widely distributed in the littoral zone of the Indo-Pacific from the Red Sea (Ljungman, von Martens, Koehler); southward to East Africa (von Martens); Zanzibar (Koehler); Madagascar (Hoffman); Ile de France (Muller and Troschel); Mauritius (Michelin, de Lorient, Mobius, Koehler); Mascarenes (von Martens); and eastward to Ceylon (Bell, Walther); China Sea, off southern Luzon, 12-13 fathoms (Koehler); Sunda Isles: Java (Ljungman, Koehler, H. L. Clark); Borneo Bank, Karkaralong, Kur Isle, entrance to Nusa Besi and Saman Isle (Koehler); Amboina (Brock); coral reefs, Timor (Studer); Torres Straits, Murray Islands, Mer (H. L. Clark); Ternate (Lyman); China Straits, New Britain (Bell); Kingsmill or Gilbert Islands (Lyman, Ljungman, Clark); Sandwich Islands (Lyman); Honolulu Harbor, Maui, Hilo, Hawaiian Islands, Pearl and Hermes Reef, Laysan Island, Ocean Island, Wake Island, Johnston Island (Clark); Honolulu Harbor, Oahu (Boone); Society Islands (Ljungman, Clark).

MATERIAL EXAMINED: Four specimens from Pearl Harbor, Oahu, Hawaiian Islands. Twenty-one specimens, Kaneohe Bay, Oahu, 2 fathoms low tide, December, 1928, collected by the "Ara."

TECHNICAL DESCRIPTION: The disk diameter of the largest specimen is 20 millimeters, total arm length 50 millimeters, of the second specimen 15 millimeters disk diameter and 27 millimeters arm length, of the third specimen, 13 millimeters disk diameter, 24 millimeters arm length, of the fourth specimen, 8 millimeters disk diameter and 18 millimeters arm length, thus showing a variation of arm length of from twice to two and a half times the related disk diameter, in the Pearl Harbor series.

The disk is circular in contour, moderately thick, with the abactinal and actinal surfaces of the interbrachial regions covered with coarse, rounded granules which form a continuous pavement. The mouth shield is an elaborate lozenge shape, with the inner margin truncate and nearly twice as broad as the opposite outer narrowed margin and the paired inner lateral margins oblique and slightly longer than the related paired outer lateral margins. The paired side mouth shields are triangulate fitting closely around the margins of the central mouth shield, the apices of the side mouth shields lying adjacent, on either side, to the distal lateral angle of the mouth shield and being separated from

each other by the width of the truncate inner distal margin of the central mouth shield. There are twelve to fourteen mouth papillae per jaw-angle, each side of which has one squarish, blunt tooth at the jaw-angle, followed by a second, wider, blunt tooth, then two, elongate, conical subacute, strong teeth, with a cluster of about four smaller, but strong, distally widely rounded or blunt teeth at the apex. The teeth are all strong with wide truncate apices predominant.

The arms are short, averaging from twice to two and a half times the disk diameter, in the four Pearl Harbor specimens, giving the effect of being rather wide, with the arm spines numerous and closely crowded. The under arm plates are wide, with the distal margin widely convex, about one-fifth longer than the nearly straight proximal margin; the side margins are concave. Two tentacles scales are present, of which the inner one is a trifle the larger and longer and more narrowly tapered distally, while the outer scale is widely convex distally. The side arm plates bear five spines each proximally, distally there are sometimes only four spines. These spines are stout, conical, with blunt, rounded tips and increase very slightly in length from the ventral to the fourth or subdorsal spine, the fifth, or dorsal, spine usually being about equal to the fourth spine in length. The first, or ventral, spine is about 2.25 times as long as the greatest width of the related dorsal arm plate, or equal to about the combined length of two dorsal arm plates.

The dorsal arm plate has the surface entirely covered with pearly granules, skin-embedded. This plate is somewhat fan-shaped, with the proximal margin about one-half as wide as that of the widely convex distal margin, the paired, oblique, lateral margins uniting these two at a depth only a millimeter shorter than the greatest width of the convex outer margin.

Each of the twenty-one specimens taken in Kaneohe Bay has the distinctive colour pattern of fine radiating golden yellow lines on the dark brownish black disk. This series shows specimens ranging in size from very young forms having a diameter of 6 millimeters to large ones, with a disk diameter of 25 millimeters. The ratio of arm length to disk diameter ranges from 1.5, 2, 2.25, to in very young forms, 2.5.

These measurements of the Kaneohe Bay specimens are given below, in millimeters:

<i>Disk Diameter</i>	<i>Arm Length</i>		<i>Disk Diameter</i>	<i>Arm Length</i>
25	50		13	28
16	28		14	22
15	34		14	32
9	22		15	36
6	15		6	14
14	Broken		12	26
20	31, Broken		13	Broken
14	25		7	18
17	26		19	40
20	30		9	18
15	25			

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Ophiocoma lineolata, MULLER, J., and TROSCHER, F. H., Syst. der Asteriden, 1842, p. 102.—MICHELIN, H., Mag. de Zool., 1845, p. 26.—DUJARDIN F., et Hupe, H., pt. 12, Hist. Nat. des. Echinodermes, 1862, p. 625.—LJUNGMAN, K., Vetenskaps Akad. Forh., 1866, p. 329.—VON MARTENS, E., in von der Decken's Reisen in Ost., Afrika, t. III, p. 129.—HOFFMAN, C. K., Recherches sur Madagascar, pt. V, 1874, p. 58.—WALTHER, A., Jenaische Zeitsch. fur Naturwiss., 1885, Bd. XVIII, p. 370.—DE LORIO, P., Mem. Soc. Phys. et. Hist. Nat. de Geneve, 1893, t. XXXII, p. I, No. 3, p. 28.—KOEHLER, R., Bull. C. U. S. Nat. Mus., vol. V, Ophiurans, 1922, p. 324, pl. 73, figs. 1-4.

Ophiura pica, MULLER, J., and TROSCHER, F. H., loc. cit., p. 101.—DUJARDIN, F., et Hupe, H., loc. cit., p. 265.—LYMAN, TH., Illus. Cat. Mus. Comp. Zool., No. I, Mem. vol. I, 1865, p. 90; A Preliminary List of the Living Ophiuroidea and Astrophytidae, Cambridge, Mass., 1880, p. 27; Rept. Voy. H. M. S. "Challenger," Zool., 1882, vol. V, Ophiuroidea, p. 171. — MOBIUS, Beitrage zur Meeresfauna Insel Mauritius, 1880, p. 50.—STUDER, TH., Abhandl. der Berliner Akad. d. Wissensch., 1882, p. 21.—BELL, J., Trans. Roy. Soc., Dublin, 1887, vol. III, p. 648. BROCK, J., Zeitsch. fur Wissensch. Zool., Leipzig, 1888, Bd. XLVII, p. 495.—CLARK, H. L., Mem. Mus. Comp. Zool., 1915,

vol. XXV, No. 1003, p. 293; Papers Dept. Mar. Biol., Carnegie Inst., Wash., 1921, Publ. 214, vol. X, p. 127, pl. 13, fig. 8 (colour plate); Bull. XXVII, Bernice P. Bishop Museum, Publ. No. 1, Honolulu, p. 93.

Ophiocoma sannio, LYMAN, TH., Proc. Bost. Soc. Nat. Hist., 1861, vol. VIII, p. 81.

Ophiocoma scolopendrina (Lamarck)

1

Plates 53 and 54

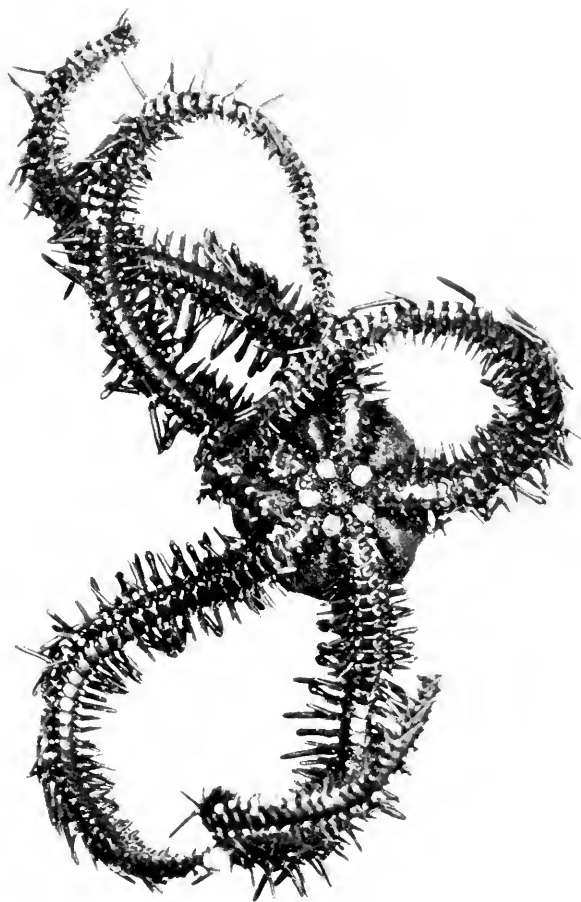
TYPE: Lamarck's type inhabited the southern (Indian) Ocean in the vicinity of the Ile de France (Mauritius), and is deposited in the Paris Museum.

DISTRIBUTION: *Ophiothrix scolopendrina* is very widely distributed in the littoral region of the Indo-Pacific, having been reported from the Red Sea southward on the East African coast to the Cape of Good Hope, also eastward through the Gulf of Arabia, Indian Ocean and in the Pacific northward to Kagoshima, Japan, and eastward to the Hawaiian Islands and southward to Australia and the Society Archipelago.

The following valid records have been published: Red Sea (Muller and Troschel, Koehler (Paris Coll.); Muscat and Perim, Arabia (Koehler); Suez, Djibouti (Koehler; Ludwig); Tor, Red Sea, Djedda (Marktanner); Grand Comoro and Mayotte Islands, in the Mozambique Channel (Koehler); East Africa; Mozambique (Lutken, Marktanner, Peters, H. L. Clark); east African coast (Clark, von Martens); Madagascar (Hoffman, Koehler, H. L. Clark); Aldabra, Zanzibar (Ludwig, Koehler, H. L. Clark); Simon's Bay, Cape of Good Hope, 10-12 fathoms (Lyman, H. L. Clark); Indian Ocean, near Mauritius (Lamarck); Mauritius (Michaelsen, H. L. Clark); Mahe (Koehler); Reunion Isle (Koehler); Seychelles Islands (H. L. Clark); Reunion Isle, Nicobars (Marktanner); Gulf of Arabia (H. L. Clark); Indian Archipelago (Lutken); Indo-Pacific (Lutken); Ceylon (Bell, Walker); Tuticorin, Madras (Bell); Andaman Islands (Bell); Nicobars (Lutken, Marktanner); Owen Island, Mergui Islands (Duncan); Singapore; Dutch East Indies: Pulotikus Bay, Sumatra, Palabuan,



Ophiocoma scolopendrina (Lamarck), $\times 1.5$, from Samoa.



Ophiocoma scolopendrina (Lamarck), $\times 1.5$, from Samoa.

southwest coast of Java, Banka Straits, Larantuka, Flores Island, Banda Sea, Baque Isle, twenty-nine Siboga stations in the Dutch East Indies, Java, Borneo, etc. (Koehler); Ternate (Pfeffer); Amboina (von Martens, de Loriol, Doderlein, Marktanner, Brock); Halmaheira Islands; Philippine Islands: Samboangan Banks, Zebu Reefs (Lyman); Cebu (Marktanner, H. L. Clark); Pulo Condor, China Sea (Koehler); Japan: Pinnacle Island, Bonin Islands, Botel, Tobago, Koshun, Formosa, Riu Kiu Islands, Yaya-yama, Oshima, South Osumi, Kagoshima Gulf (the most northern coastal record in Japan (Matsumoto); Japan (H. L. Clark); New Guinea: Port Moresby (Bell); Sorong (H. L. Clark); Salawatti Island, northwest coast of New Guinea (Studer); New Guinea (Koehler); Ponape and Ualan or Strong's Island, Caroline Islands (H. L. Clark); Anchorite Islands, New Hanover, Bismarck Archipelago (Studer); Torres Straits (Marktanner); Mer and Murray Island, Torres Straits (H. L. Clark); Port Denison, Queensland (Bell); Shark's Bay, several stations, southwest Australia (Koehler); New Caledonia (Koehler); Espiritu Santo Island, Tangoa, New Hebrides (Studer); New Hebrides (Clark); Gilbert Islands or Kingsmill Islands (Lyman, H. L. Clark); Ebon or Boston Island, Marshall Islands, Strang's Island, Caroline Islands (H. L. Clark); Fiji Islands (Lyman, Marktanner), Viti Levu, Suva Reefs, Nukilan Island and Manuku Islet, Fiji Archipelago (H. L. Clark); Samoa (Ljungman, Lyman); Tonga Islands: Tongatabu, 18 fathoms (Lyman, Koehler, Studer); Society Islands (H. L. Clark, Boone); Tahiti (Marktanner); Hawaiian Islands (as Sandwich Islands, Koehler).

MATERIAL EXAMINED: Two specimens, Teviatea Reef, Raiatea Island, Society Islands, August 21, 1931, in coral; one young specimen from Venus Point Reef, Tahiti, August 15, 1931; three specimens from Ingham Island, Queensland, October 12, 1931; five specimens from Pago-Pago, Samoa, September 2, 1931; two specimens, Apia, Samoa, September 2, 1931.

TECHNICAL DESCRIPTION: This is one of the large species of littoral ophiurans of the Indo-Pacific. Numerous variations from the typical form of the species have been recorded by several authors. Those of de Loriol, Koehler, and H. L. Clark are of especial interest. The close affinity of *scolopendrina* and *erinaceus* has prompted several students to consider them one species. Mr. Clark (1921) and M. Koehler (1922), after careful research,

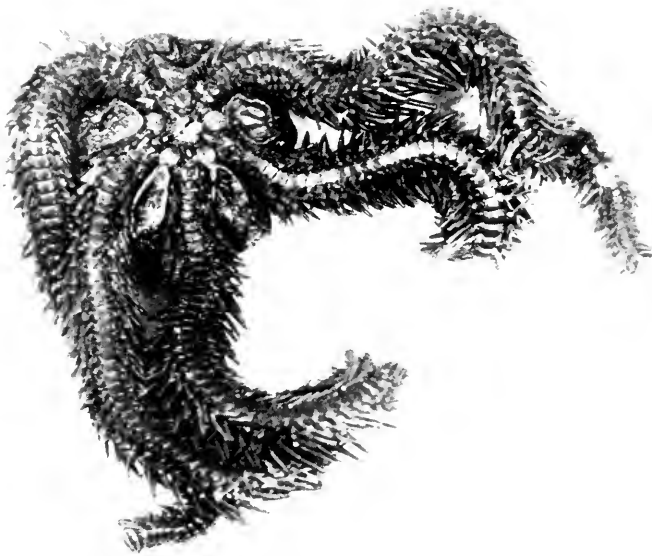
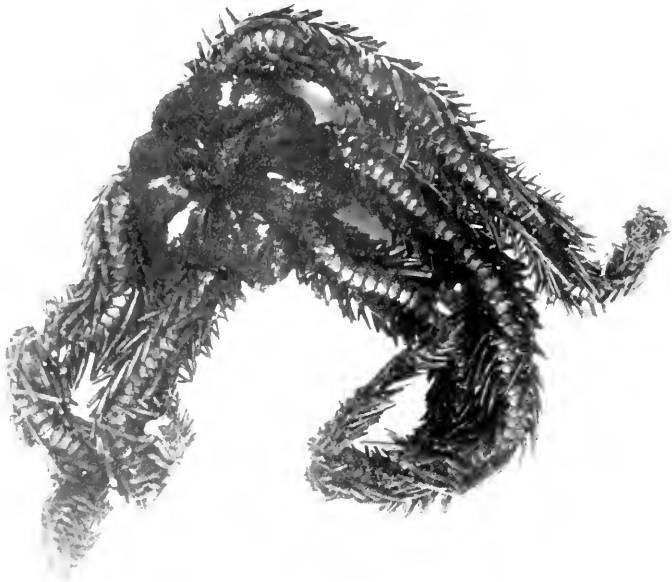
based on extensive material, have each concluded that these two are distinct but closely related species. M. Koehler points out the several secondary characters by which *erinaceus* may be distinguished. Mr. Clark records observations made of the living animals on the reefs in Torres Straits, where *scolopendrina* was very abundant.

Ophiocoma molaris Lyman and *Ophiocoma lubrica* Koehler are also placed as synonyms of *scolopendrina*.

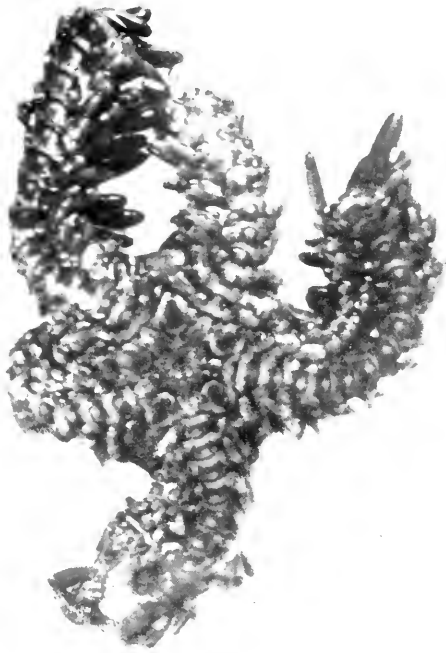
A typical "Alva" specimen, taken at Samoa, has the disk circular, with a diameter of 20.5 millimeters and the arms measuring from 60 to 65 millimeters long. The abactinal surface of the disk and the interbrachial regions of the actinal surface are covered with coarse, rounded, blackish granules which almost touch one another but do not overlap, there being 12 to 15 granules per square millimeter. No radial shields are visible. The mouth shield is small, somewhat shield-shape, being widest across the outer third of the shield, with the outer margin beyond this point rounded and the inner lateral borders slightly convergent to the broadly truncated inner margin. The side mouth shields are triangular, fitting close to the inner lateral margins of the central shield and not meeting inwardly. There are five mouth papillae on each side, the outer two of these being very wide, bluntly truncated distally; these are followed by three, each one-half so wide, blunt, distally small teeth, on either side of the similar but smaller, subacute cluster of three apical teeth. The teeth are strong with widely truncate, blunt tips.

The arms are comparatively wide and stout. The under arm plates are small, broad-axe shape, with the inner margin narrowed, nearly straight, usually concealed by the overlapping adjacent plate; the distal margin is widely convex; the side margins are concave for the greater portion, beside the tentacle pore and beyond this are directed obliquely inward the proximal margin.

The tentacle scale is wide, oval. The side arm plates each bear four spines. These spines increase in size appreciably from ventral to dorsal of the series. Each spine is quite stout, blunt tipped, being definitely thicker throughout the proximal half and tapered slightly on the distal half. The dorsal arm plates are small, wider than long, being 1 millimeter long and 2 millimeters greatest width, with the inner margin short, being only about one-fifth of total arm width, straight, the lateral margins are oblique and the



Ophiocoma wendtii Muller and Troschel, natural size, from Kaneohe Bay,
Oahu, Hawaii, 1 fathom.



Ophiocoma wendtii Muller and Troschel, young adult, $\times 3$,
from Kaneohe Bay, Oahu, Hawaii, 1 fathom.

outer margin widely convex. The entire dorsal surface of the upper arm plates, the visible portion of the side arm plates and the ventral arm plates are paved or reticulated with a continuous series of coarse low rounded granules.

The single young specimen taken on Teviatea Reef has a disk diameter of three millimeters, but possesses the essential diagnostic characters of this species.

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Ophiocoma scolopendrina, AGASSIZ, L., Mem. Soc. Sci. Nat. Neuchatel, 1835, t. I, p. 192.—LUDWIG, H., Zeit. f. Wiss. Zool., 1879, Bd. XXXI, heft II, p. 383.—DE LORIO, P., Mem. Soc. Physique et Hist. Nat. Geneve, 1894, t. XXXII, pt. I, No. 3, p. 23. (M. de Lorio gives an exhaustive early synonymy of the species.)—KOEHLER, R., Siboga-Expeditie, Ophiures Littorales Monogr. XLV-B, 1905, p. 60 (with additional synonymy); Bull. C. U. S. Nat. Mus., 1922, vol. V, p. 325, pl. 73, fig. 5, pl. 74, figs. 1-7 (with additional synonymy).

Ophiocoma wendtii Muller and Troschel

Plates 55 and 56

TYPE: The type was collected by a Captain Wendt and deposited in the Berlin Zoological Museum, where it is recorded from an unknown locality.

DISTRIBUTION: It has since been recorded from the Seychelles Islands, Fernando Velosa, New Ireland, Little Santa Cruz Island, Zamboanga, Philippines, Batavia, Sharks Bay, southwest Australia, Samoa and the Fiji Islands (Koehler). The present "Ara" record appears to be the first of this species from the Hawaiian Islands. It is restricted to the littoral zone.

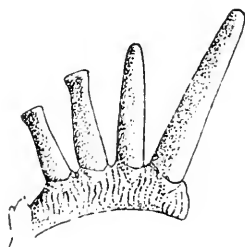
MATERIAL EXAMINED: One very large and one small young specimen taken at low tide, depth one fathom, Kaneohe Bay, Oahu, Hawaiian Islands, December 15, 1928.

COLOUR: Disk deep blackish brown; this color repeated on the arms.

TECHNICAL DESCRIPTION: The disk is rounded pentagonal, moderately thick. The disk diameter of the large specimen is 35 millimeters, the arm length about 108 millimeters, the dorsal width of the arm between the spines is 5 millimeters; length of the arm spines (about the fifteenth somite, dorsal to ventral) 7.5, 4, 3.4 millimeters, respectively. The abactinal surface of the disk and interbrachial areas of the actinal surface are covered with fairly coarse rounded granules. Where abraded, the scales beneath these granules are small, regularly overlapping, with convex outer margins. The central mouth shield is longer than wide, with the inner portion definitely narrower than the outer, bounded by a rounded apex from which the slightly rounded lateral margins diverge posteriorly, their outer angles also rounded and the proximal margin wide, also slightly convex. In the very young specimen the central mouth shield differs from that of the large specimen in appearing longer in ratio to the proximal border, which in the smaller specimen has the outer lateral margins converging very much to a narrowed proximal border, much as in the specimens figured by M. Koehler (1905). The side mouth shields are triangulate, each plate lying adjacent to the lateral border of the central plate, with the inner apices separated. The four teeth on each side of the jaw-angle are truncated, the first, or outermost, being 1.5 times as wide as the second, which it slightly overlaps, the second tooth similarly overlaps the narrower, squarish third tooth which is nearly a third wider than the fourth; there are two smaller, subequal teeth at the apex of the jaw-angle. The teeth papillae, about 18 in number, are set in three to four series, extending downward and outward. There are four large, flat, squarish teeth, of which the uppermost one is the smallest.

The arms are a little over three times as long as the disk diameter. The ventral arm plates are slightly wider than long, hexagonal, with the distal margin widely convex, the paired lateral margins concavely excavate anteriorly and posteriorly obliquely convergent to the short, relatively straight proximal margin. In this large Hawaiian specimen the proximal ten somites of the arm occur within the radius of the disk and each somite bears only three spines on each of these side arm plates. In each instance these spines consist of two claviform and a third, dorsal, short, tapered, cylindrical spine. Beyond this on the arm, the side arm plates bear in irregular alternation four or three spines per

somite. These spines sometimes occur in the sequence 4, 4, 3, 4, 3, or 4, 3, 3, 4, 3, 3, 4, and sometimes 4, 3, 4, 3, the fourth or dorsal spine being definitely longer where it is alternated by two three-spined somites than it is when alternated by only one three-spined somite. The arm spines are of two distinct types: (a) the compressed, claviform, which occur uniformly in the ventral and next to ventral spines, and (b) the tapered, cylindrical forms which occur in the third or subdorsal and dorsal spines. The claviform



Text figure 8.—*Ophiocoma wendtii* Muller and Troschel, arm-spines $\times 5$.

spines are proximally subcylindrical, but abruptly become decidedly compressed in the proximal-distal axis of the arm plate, the broad surfaces of the spine having also this direction; the tips of these spines are truncate, laminate, in the young, thickish and sometimes slightly expanded fanwise in the large specimen. The cylindrical spines are thick throughout their length, although tapering distally, with truncate or bluntly rounded apices. In the very young specimen these spines are more swollen medially than in the older specimen and their apices are more convex. The dorsal arm plates are wider distally than long, fan-shaped, with the proximal margin short, the paired lateral margins obliquely divergent, thence to the widely convex distal margins.

The young specimen from the same locality has a disk diameter of 5 millimeters, and all five arms incomplete, but with the longest broken arm showing fifteen somites, the proximal five of which are within the radius of the disk, each of which somites bear three spines, two claviform and one cylindrical; the eleven somites beyond the disk each possess in regular alternation 4, 3, 4, 3 arm spines. Even in so young a specimen these spines show distinctly

the two types characteristic of *Ophiocoma wendtii* Muller and Troschel, and in the typical length ratio. The young claviform spines differ from those of the older specimen in that their apices are thinner, laminate and less dilated, and the cylindrical spines of the young are more swollen medially and more convex distally.

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Genus: OPHIOMASTIX Muller and Troschel

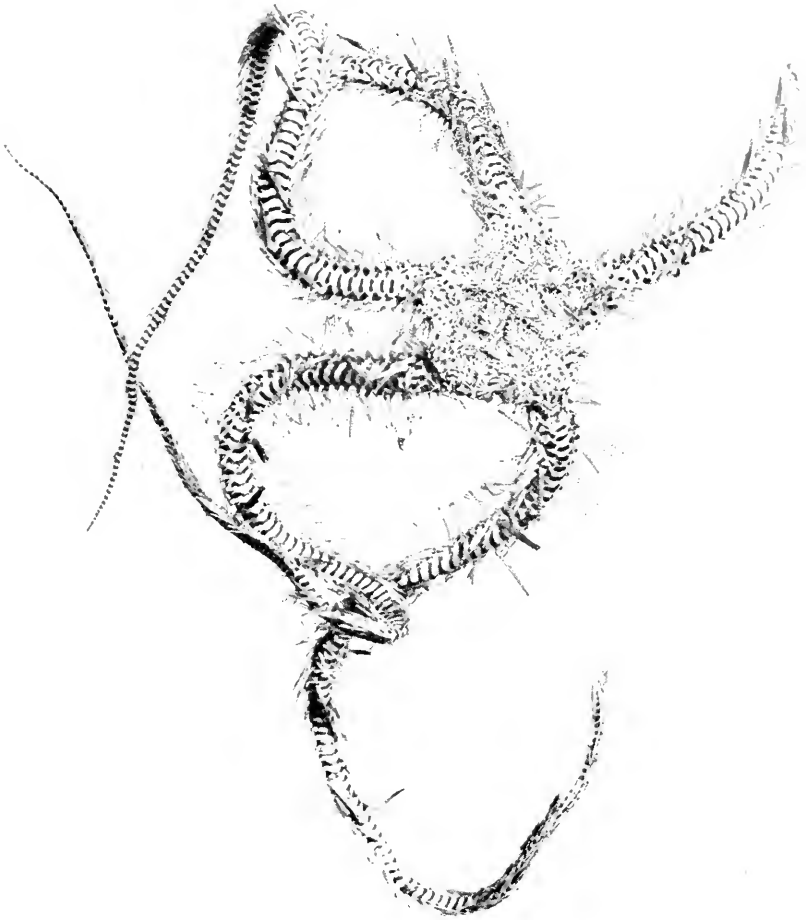
Ophiomastix lutkeni Pfeffer

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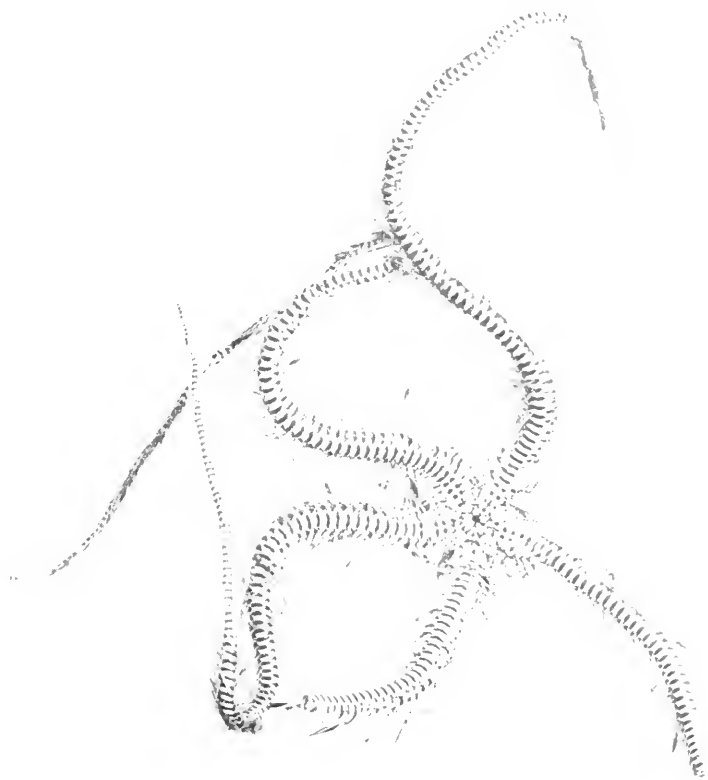
Plates 57 and 58

TYPE: Pfeffer's type description records the species from Ternate, also from Cebu, P. I., in the zoological collections of the Hamburg Museum.

DISTRIBUTION: This strikingly beautiful species is rather rare in the collections of museums. In addition to the type, there is one specimen from Okinawa, Riu Kiu Islands, Japan, in the Museum of Comparative Zoology; four specimens from this same locality in the Zoological Institute of the Imperial University of Tokio; one specimen, in poor condition, from "Albatross" station 5109, China Sea, 12 fathoms, in the United States Museum, and two magnificent specimens from Bali, in the Vanderbilt Marine Museum.



Ophiomastix lutkeni Pfeffer, natural size, from Temukus Roads, Bali.



Ophiomastix lutkeni Pfeffer, natural size, from Temukus Roads, Bali.

MATERIAL EXAMINED: Two specimens, taken in coral, Temukus Roads, Bali, Dutch East Indies, October 25, 1931.

TECHNICAL DESCRIPTION: Disk pentagonal in the preserved specimens, diameter 18 millimeters. Abactinal surface with the radial shields small, almost or entirely concealed beneath the imbricated, spine-bearing scales. Some, but not all, of the radial plates are visible near the circumferal border, vanishing beneath the scales. When dissected, the radial plates of a pair are separated from each other along the inner margins by a wedge-like area covered with imbricated scales, most of which bear long spines. The radial plate has the outer margin sinuate-convex, the lateral margins converging to a subacute apex which extends inward less than half the radius of the disk. The abactinal surface, including the radial and interradial areas, is continuously paved by small, imbricated scales, the outer free margin of each is convex; these scales are somewhat irregular shape, about one millimeter long, or more. They extend abundantly to the circumferal margin and upon the actinal interradial spaces, only the scales near the middle mouth plate and along the margin of the genital slits being devoid of spines. The scales of the disk are practically concealed beneath the numerous long, conical spines, each of which is articulated, the base dilated into a convex knob that fits into its concave support, which is a tabular elevation from a scale, dorsally concave, encupping the base of the spine. The spines are conical, very acuminate, 1.5 to 1.8 millimeters long, with the surface covered with fine serrations, arranged in approximate longitudinal series, which near and at the apex of the spine become spinules. The central mouth plate is nearly oval, 2.5 millimeters long, 1.5 millimeters median width, with the inner end more narrowly rounded and the outer end nearly truncate. The side mouth plates do not meet at the inner apices; each plate is nearly an equilateral triangle, with the outer angle rounded and touching the first under arm plate. The mouth-frame is composed of two elongate pieces, meeting inwardly in the median line and widest here, thence narrowing and extending backward beside and as far as the outer angle of the side mouth plate. There are five mouth papillae, including the proximal one, first tentacle scale, which is a long triangle, basally applied to half of the inner margin of the side mouth plate and also applied on the outer lateral margin to the first small ventral arm plate and apically has a long

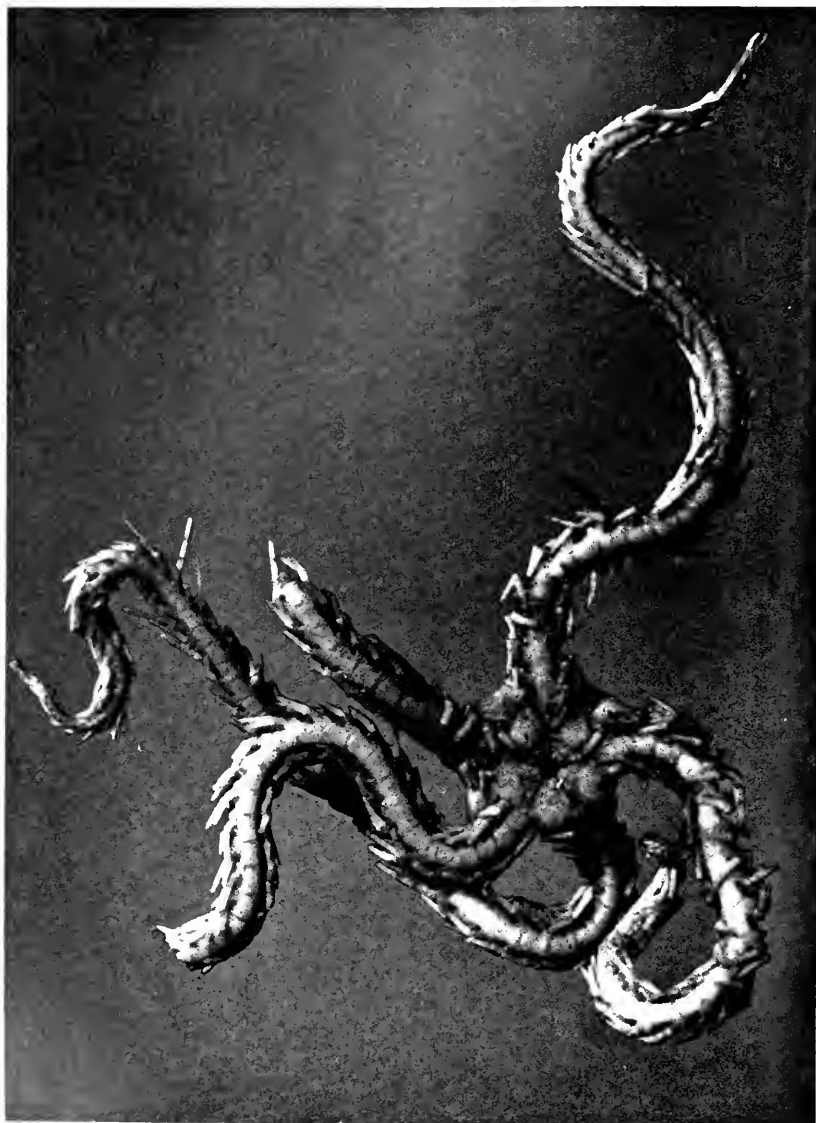
acute point directed inward. The adjacent mouth papilla is large, squarish or irregular shape, distally blunt; twice as wide as the third mouth papilla, which is longer and more pointed than the second one, which is subequal to the first mouth papillae, each of these two being a little longer and more pointed than the teeth. There are two teeth, each one being oval in contour, distally acute.

The arms are five, long and very tapered, about 108 millimeters long. The under arm plate is widely convex on the distal margin, recurvate, the inner margin short, concealed by the overlapping of the adjacent plate. There are two tentacle scales, on either side of the under arm plate. The outer scale is widely oval and longer than the inner one, which is applied to the anterior side margin of the under arm plate and is more narrowly oval and sometimes subacute on its free distal margin. The side arm plate extends narrowly upon the ventral surface and also upon the dorsal, the distal margin being moderately convex. This plate supports three, long acicular spines which definitely increase in length from the ventral to the dorsal. Each spine has the surface roughened with fine serrations in approximate longitudinal series, these being spinulose along the margin and tip. About every seventh or eighth joint of the arm the dorsal spine is greatly elongated and thickened, sometimes tapered distally, but more frequently compressed and abruptly truncate with serrate or spinulose margin. The dorsal arm plate is rhomboidal, in some cases approaching hexagonal, because the widely convex distal margin tends to break into a median and two lateral parts. The lateral margins are oblique, closely bordered by the side arm plates and the proximal margin is narrowed to one-half or less the width of the distal margin. The surface of all the arm plates is microscopically granulose.

The species has a striking color design. The original colors have been described by Dr. H. L. Clark and others. The present specimens, preserved for five years in alcohol, show the disk maculated with dark brown and white in a pattern of irregular shaped figures on both the abactinal and actinal surfaces and the spines of the disk are transversely ringed or partially ringed by interrupted dots of brown alternating with cream. The arms are transversely ringed on all surfaces with alternating brown and cream, the proximal half of each the dorsal, side and ventral arm plates is brown, the distal portion being a cream banding. The three



Ophiarthrum pictum (Muller and Troschel), $\times 3$, from
Ingham Island, Queensland.



Ophiarthrum pictum (Muller and Troschel), $\times 3$, from
Ingham Island, Queensland.

arm spines are each ringed with eight to ten bands of brown alternating with cream, except the greatly enlarged dorsal occasional spine, which is brown throughout the entire length.

The present specimens of *Ophiomastix lutkeni* differ from those previously described in possessing very numerous spines all over the abactinal, circumferal and outer actinal surfaces and also in the absence of large abactinal granules. Some large granules are present, but under magnification these prove to be only the supporting basal tubercles of the long spines, from which the related spines have become dislocated, each granule or tubercle showing dorsally a median concavity into which the base of the spine fitted, similar to the attachment of the primary spines of a typical sea-urchin.

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Ophiarthrum Peters

Ophiarthrum pictum (Muller and Troschel)

✓

Plates 59 and 60

TYPE: Muller and Troschel's type was brought from Java by Kuhl and Van Hasselt and deposited in the Leyden Museum. It remained for a long time a unique specimen.

DISTRIBUTION: This species has since been taken on islands near New Guinea (Lyman); in the Philippine Islands; Pelew Islands (Lyman, H. L. Clark); Torres Strait: Murray Islands, Mer (H. L. Clark).

MATERIAL EXAMINED: One specimen, taken at Ingham Island, Queensland, Australia, October 12, 1931, by the "Alva." This appears to be the most southern record of the species in Queensland.

TECHNICAL DESCRIPTION: The disk is pentagonal, with the circumferal margin of each interbrachial area concave. The disk diameter is 9 millimeters. The abactinal and interrachial areas of the actinal surface are similarly encased in a tough integument which has numerous coarse, rounded or rough granules embedded therein. The genital slits are long. The abactinal surface of the disk is heavily pencilled with meandrine brown lines which define a pattern of irregular lozenge-shape design. The central mouth shield is deeper than wide, heart-shape, with the rounded apex directed inward. The side mouth shields are rather wide, triangular, with the tapered apices almost, but not quite, meeting within. Mouth papillae four on each side of the jaw-angle, the outer of which is tapering and pointed, the second is wider than long and rounded, the third and fourth, or innermost, mouth papillae are squarish. There is a total of fifteen nearly equal, bead-like tooth papillae. There are four teeth, of which the upper one is the largest; all are stout, thick, with rounded corners and blunt cutting edge.

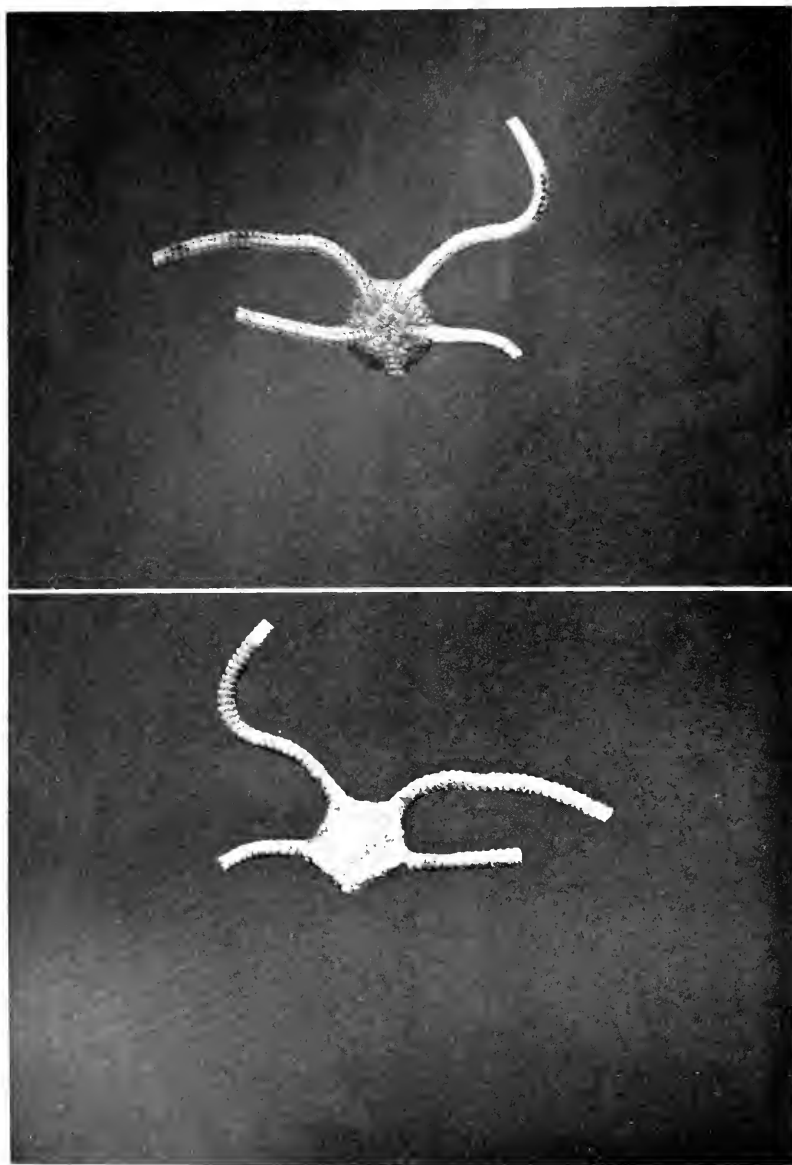
The arms are encased in a tough integument, similar to that of the disk with that of the dorsal surface regularly granulose; the arm plates show through this skin. The ventral arm plate is longer than wide, with the distal margin regularly convex, the proximal margin very narrow, and the lateral margins oblique proximally, thence concave for their greater distance, beside the tentacle scale. There is but one tentacle scale, which is very widely oval, flat.

The side arm plates are wide, with the distal margin convex. Each plate supports two or three spines, the dorsal of which is the longest, this spine being one and a half to twice as long as the ventral spine; the median spine is similar to the ventral one. These spines are stout proximally, tapered distally, with conical blunt, spinose tips.

The dorsal arm plates are hexagonal, with the proximal-median and distal-median margins shorter than any of the others which are approximately equal.

There is a dark brown stripe on the upper arm. The arm spines are each ringed transversely with three to five dark brown bands alternating with cream.

Herklots' early figure of the type in colour, and H. L. Clark's



Ophiolepis cincta Muller and Troschel, $\times 1$, from Society Islands.

recent exquisite figure of the living animal show the delicate beauty of this brittle-star.

- REFERENCES: *Ophiocoma picta*, MULLER, J., and TROSCHER, F. H., Syst. der Asteriden, 1842, p. 102.—DUJARDIN, F., et Hupe, H., Hist. Nat. Zoophytes Echinodermes, 1862, p. 265.—HERKLOTS, J. A., Bidragen to de Dierkunde, Genoots. Natura artis Magistra, 1869, Amsterdam, p. 12, pl. 5, fig. 2 (figures type.)
- Ophiarthrum pictum*, LYMAN, TH., Bull. Mus. Comp. Zool., 1874, vol. III, p. 225, pl. 7, figs. 2-4; Rept. Voy. H.M.S. "Challenger" Zool., 1882, vol. V, Ophiuroidea, pp. 174, 312, 325.—BROCK, J., Zeit. Wiss. Zool., 1888, Bd. LXVII, p. 497.—KOEHLER, Siboga-Expeditie Ophiures Littorales, Monogr. XLV-b, 1905, p. 72.—CLARK, H. L., Mem. Mus. Comp. Zool., 1915, vol. XXV, p. 296, entry 1029; Publ. 214, Carnegie Inst., Washington, Papers Dept. Marine Biol., 1921, vol. X, p. 140, pl. 12, fig. 1 (colour).

Family: **OPHIOLEPIDAE**

Genus: **OPHIOLEPIS** Muller and Troschel

Ophiolepis cincta Muller and Troschel

1

Plate 61

TYPE: The type was collected in the Red Sea by Hemprich and Ehrenberg and is deposited in the Berlin Zoological Museum.

DISTRIBUTION: This species has a wide distribution in the littoral zone of the Indo-Pacific, having been recorded from the Red Sea, southward on the east African coast to Zanzibar and eastward in the Philippines, Amboina, Torres Strait at Thursday Island, Badu, Murray Island and Mer, in New South Wales at Port Jackson, and in the south-central Pacific at Ponape, Caroline Islands and Society Islands.

MATERIAL EXAMINED: One specimen, taken at Raiatea Island, Society Islands, August 21, 1931.

TECHNICAL DESCRIPTION: The disk is decidedly pentagonal, with a diameter of 10 millimeters; the arms are broken, but appear to be from four to four and a half times as long as the disk diameter. The abactinal surface of the disk is paved with large and

small flat half circular to half oval scales. There is a central large circular scale, the circumference of which is uniformly margined with small, squarish to rectangular scales. Around this central scale are five similar large scales, overlapping to form a rosette, and beyond these are many other similar smaller scales, increasing the rosette pattern. In each interbrachial area there is, in the median line, a series of three large scales, forming a sort of band from the central rosette to the lateral margin; on either side of this band there is a bordering band, composed of similar, but definitely smaller scales, which also margin the radial area.

The actinal surface has the interbrachial area paved with scales similar to those of the abactinal surface. All of these scales are on the exposed or convex margins with a band of small squarish or rectangular scales. The genital slit is long, bordering the inserted arm for a distance equal to four or five under arm plates, extending from the jaw-angle almost to the circumferal margin and margined on either side by narrow linear plates, similar in width to the small squarish scales that margin the larger ones.

The central mouth shield is rather large, filling the entire apex of the interbrachial angle; the outer margin is widely convex and is bordered by a linear series of scales like those of the other squamae; the inner margins of the shield are two oblique lines converging to form an acute apex. The side mouth shields are large, subrectangular, extending along the oblique inner margin of the central shield and almost meeting at the apex, being separated by a small squarish plate, or two smaller plates. The jaw angle contains five coarse mouth papillae on either side; the outermost of these is long triangular, the next two being squarish, while the fourth and fifth papillae are smaller, squarish. The central teeth are coarser than the papillae, wider than long with the cutting edge rounded, or in some instances subacute.

The ventral arm plate is distinctly axe-blade shape, with the distal margin widely convex, its width being a little more than a third of the total width of the arm; the lateral margins of the ventral arm plate are concavely excavate for their greater part beside the tentacle scale, and beyond this area proximally the lateral margin becomes a short oblique line directed inward. The inner margin is almost as short as one of these oblique lateral lines and is almost straight or very slightly concave. The ventral plate is a little longer than its greatest width.

There are two tentacle scales which together form a wide oval, set obliquely to the arm length. This oval is slightly wider at the distal end, the greatest width being about 55 percentum of the length.

The side arm plates extend well upon the ventral surface of the arm for approximately one-third of its width. The side arm plate bears four small conical spines, each of which is short, thick, conical, flattish. These are arranged in close-set series and are each about one-third as long as the adjacent plate. In addition to these spines there is one small supplementary plate in the angle between the tentacle scales and side and ventral plates. On the dorsal there is a triangulate plate at the upper distal angle of the dorsal arm plate, adjacent to and apparently partially fused with the side arm plate. Viewed dorsally, the free margin of the side arm plate has the contour of a wide arc, the upper end of which is posterior, extending back to the inner margin of the dorsal arm plate.

The dorsal arm plate is much wider than long and has the distal and proximal margins subparallel, the distal margin being widely rounded at the outer ends and confluent with the oblique lateral margins, which are directed inward posteriorly. The distal margin of each dorsal plate is bordered by a linear series of small scales, at either end of which there is a small triangular scale. The dorsal and side arm plates have their surfaces paved with microscopic, low, rounded granules.

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- STUDER, TH., Abh. d. k. Akad. d. Wiss. z. Berlin, 1882, p. 7 (et variety *nigra*).—MARKTANNER-TURNERETSCHER, G., Annal. d. k. k. Naturg. Hofmus. Wien, 1887, Bd. II, p. 294.—DUNCAN, M., Journ. Linn. Soc. Zool., 1887, vol. XXI, p. 86.—BROCK, J., Zeitsch. f. Wiss. Zool., Leipzig, 1888, Bd. XLVII, p. 475.—BELL, J., Proc. Zool. Soc., London, 1888, p. 388.—DODERLEIN, L., Zool. Jahrb., 1889, Bd. III, p. 831.—LORIOI, P. DE., Mem. Soc. Phys. et Hist. Nat. de Geneve, 1893, t. XXXII, pt. I, No. 3, p. 10; Rev. Suisse Zool., t. I, 1893, p. 398.—KOEHLER, R., Bull. Sci., France-Belg., 1898, t. XXXI, p. 66.—LUDWIG, H., Abh. Senckenb. Naturf. Gesell., 1899, Bd. XXI, heft 4, p. 544.—KOEHLER, R., Siboga-Expeditie, Monogr. XLV-B, Ophiures Littorales, 1905, p. 16; Bull. Scient. France-Belg., 1907, t. XLI, p. 287.—CLARK, H. L., Bull. Mus. Comp. Zool., 1908, vol. LI, p. 289; Mem. Mus. Comp. Zool., 1915, vol. XXV, p. 342, entry 1365.—MATSUMOTO, H., Journ. Coll. Sci. Imp. Japan, Tokio, 1917, vol. XXXVIII, p. 299.
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Echinoidea

Order: **CIDAROIDEA**

Family: **CIDARIDAE**

Group: **Cidarina**

Genus: **CIDARIS** Leske

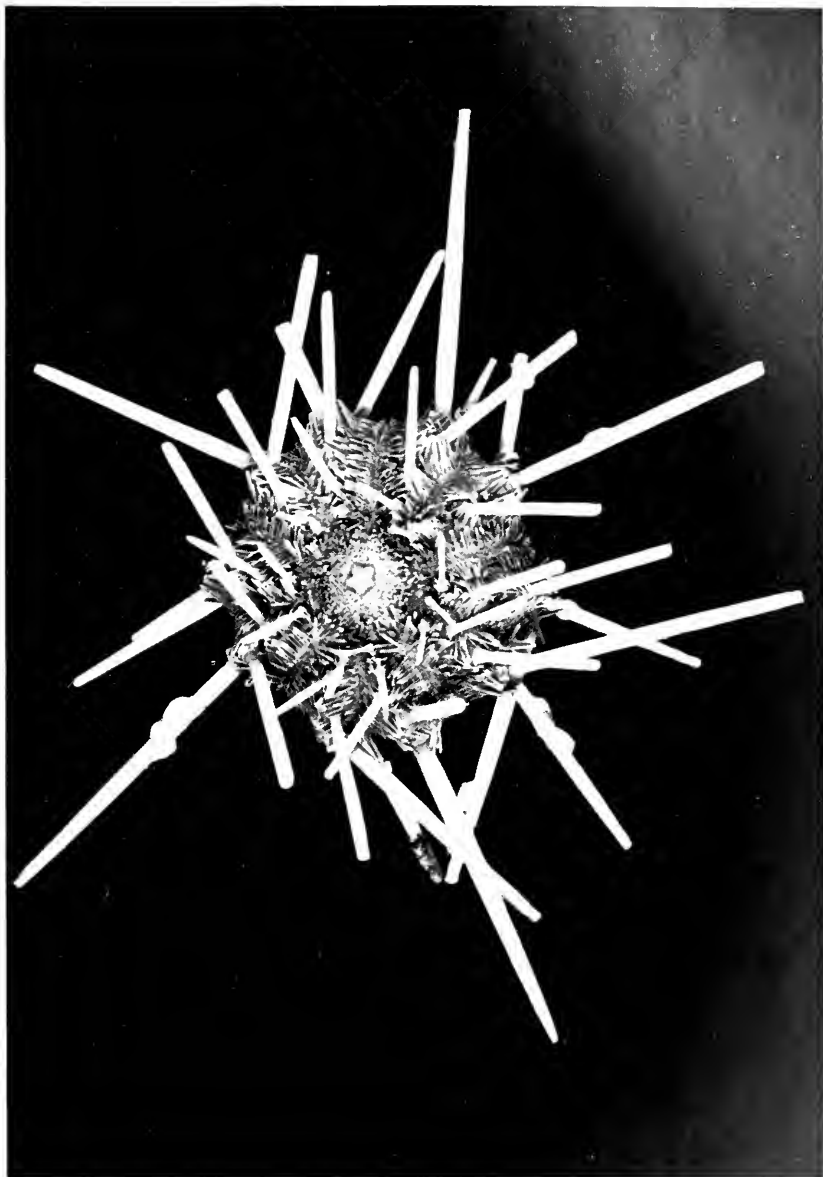
Cidaris abyssicola (A. Agassiz)

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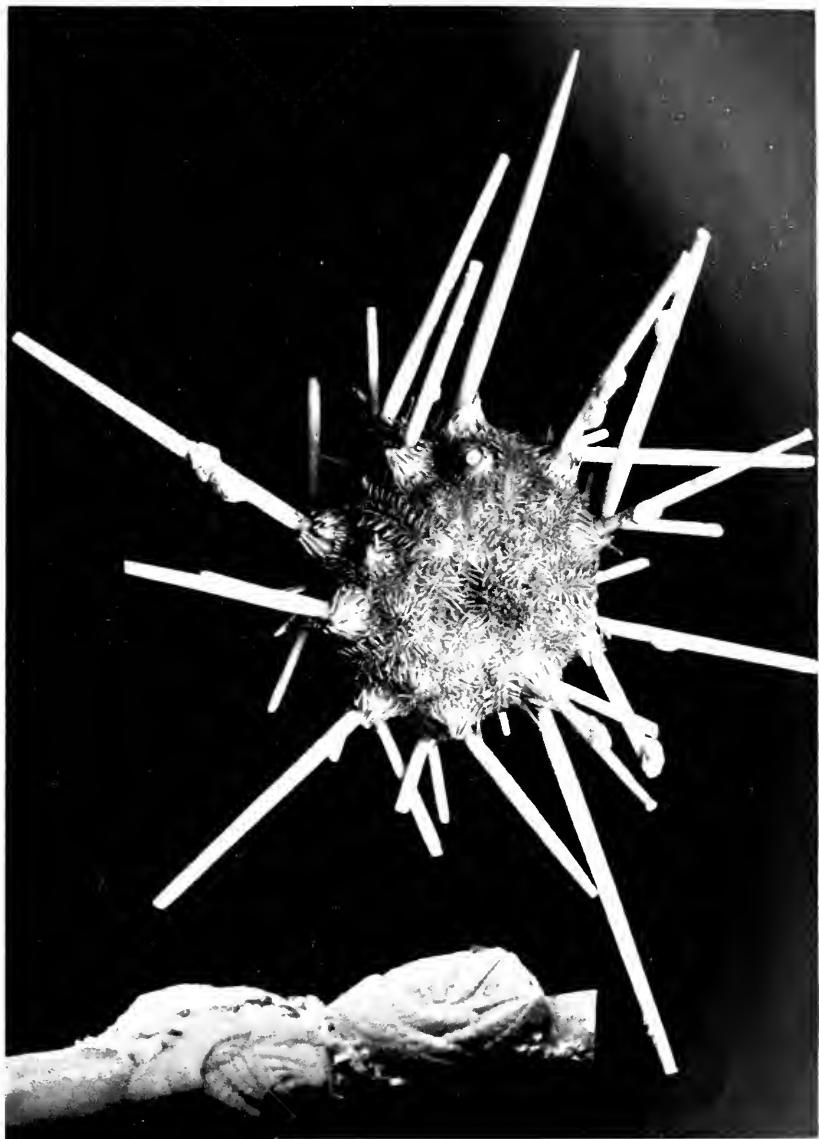
Plates 62 and 63

TYPE: The type series of this species was dredged by the United States Coast Survey Steamer "Blake" at several stations in the West Indies, in depths ranging from 40 to 270 fathoms and was deposited in the Museum of Comparative Zoology, Cambridge, Massachusetts.

DISTRIBUTION: This species has been reliably reported from numerous stations in deep water off the east coast of the United States, from south of Martha's Vineyard to southern Florida and



Cidaris abyssicola (A. Agassiz), actinal view, about natural size,
from off Sand Key Light, Florida, 100 fathoms.



Cidaris abyssicola (A. Agassiz), abactinal view, about natural size, from off Sand Key Light, Florida, 100 fathoms. Inset barnacles on primary spine of this urchin, \times about 5.

in the West Indies down to Santa Lucia, the usual bathymetric occurrence being from 100 to 200 fathoms, with an occasional shallow water depth, such as Dr. H. L. Clark's record of it in 32 meters (1908), also some records of *C. abyssicola* from depths greatly exceeding 200 fathoms, in the "Blake" and "Albatross" dredgings, where the present species was confused with *Cidaris cidaris* (Linné) and *Stylocidaris affinis* (Philippi) under *Dorocidaris papillata*. The "Alva" stations, off Sand Key Light, Florida, in 100 to 65 fathoms, add another record within the southern geographic range of *C. abyssicola*.

MATERIAL EXAMINED: Three specimens dredged in 100 fathoms, by the yacht "Alva," nine miles off Sand Key Light, Florida, bearing 311° true, March 18, 1936; 14 specimens, of various sizes, also dredged off Sand Key Light, bearing 315° , in 65 fathoms, November 25, 1935. 35 commensal barnacles, *Verruca alba* Pilsbry.

COLOUR: The "Alva" specimens were of a light straw-colour, or deep ivory, tinged with light olivaceous green, the primary spines being a deep yellowish cream with fugitive rosy tints. The denuded test is pearly white.

TECHNICAL DESCRIPTION: Test firm, pearly white, circular in outline (three young specimens approach pentagonal), much wider than high, turban-shape, sides decidedly arched, the actinal and abactinal regions similarly flattened, but with the upper showing a moderate convexity.

The peristome is normally flattish, of variable pentagonal outline, larger in ratio to the horizontal diameter of young specimens, relatively small in large specimens, being one-third to three-fifths of the width. There are twelve to fourteen ambulacral plates per series in an average large specimen. The ambulacra are slightly undulating, about 0.25 to 0.20 of the width of the interambulacra. The series of marginal tubercles is regular, evenly spaced, separated, inconspicuous. There is an inner regular vertical series of secondary tubercles, composed of one smaller secondary tubercle situated adradial to the marginal tubercle and a little below the center on each plate. On the lower margin of each plate one, two or three miliary granules are present, these forming a more numerous series on the larger specimens. There is no distinct smooth or sunken median space. The pores are in pairs, well spaced, smallish, subequal or sometimes with the outer one the

larger, the walls narrowed, rounded, the ridge distinct, rounded.

The interambulacra have the areoles of medium size and depth, well separated, except when the proximal two are contiguous, those of the actinal area variably transversely oval. The two upper areoles in one or both interambulacral series are normally rudimentary. The tubercle is small, with a low boss, the crenulation faint or nearly obsolete in nearly all specimens except two young forms, in which it is distinct. The margin of the areoles is only very moderately elevated; the scrobicular tubercles are of moderate size. The entire plate surface outside of the scrobicular ring bears numerous, closely-set, secondary tubercles, which decrease serially in size toward the median line, which is usually only slightly sunken, there normally being no bare admedian or adradial area. The median space is from one-half to two-thirds of the width of an areole.

The apical system, which is of somewhat smaller proportion in very large specimens, averages from a little less to a little more than half of the horizontal diameter in specimens of moderate size. All of the plates are regularly paved with close-set, small, subequal tubercles, except around the usually bare margin. In the present series the ocular plates are all exsert. Jackson (1912) recorded specimens in which these ocular plates were all narrowly insert. The genital pores are small, nearer to the center than to the outer margin of the plates. The periproct consists of an average number of plates.

The primary spines are from 1.4 to 1.6 times the horizontal diameter of the test in medium or large specimens, and sometimes twice this diameter in young forms. These primaries attain their greatest diameter about one-fifth of the length from the base; the diameter varies from 2.4 to 3.1 millimeters; the spines are either slenderly fusiform in varying degree or distinctly cylindrical, variously tapered to an obtuse apex or slightly widened apically. The greater portion of the primaries of the present series of *abyssicola* are of the slender, cylindrical style, tapered distally to an obtuse apex. The shaft appears smooth, white, with fugitive rosy tints; under magnification it is seen to be longitudinally striated by 18 to 24 ridges, each composed of series of low warts or granules which tend to become obsolete on the larger spines. These granules on the smaller oral primaries tend to form more distinct and relatively longer serrations proximally, while distally

they fuse to a non-serrate ridge, the apex being obtuse. The collar is about 2.1 millimeters long, increasing in thickness toward the milled ring; both are finely striated. The third primary spines are intermediate to the ambital spines.

The secondary spines are of two kinds; the scrobicular spines, which are 3.8 to 4.2 millimeters long, flattened, tapered to rounded apices, the broad outer surface frequently being transversely concave and always finely striated longitudinally. The small spines on the test and marginal ambulacral spines are only 1.8 to 2 millimeters long, much slenderer and more pointed, and in the present specimens with very large glandular ampullae.

The pedicellariae of all three types are abundant. The smaller globiferous pedicellariae average from 0.5 to 0.6 as long as the large globiferous pedicellariae, which very much resemble poppy buds in outline. The majority of the small globiferous pedicellariae have the distal third of the inner face of the valve occupied by a narrow cavity, subtriangular in outline, although even on the same specimen there is considerable individual variation existent.

The tridentate pedicellariae average 1.5 times the length of the large globiferous pedicellariae, but are quite slender with the dilated proximal cavity of each valve divided by a median cavity; the lateral margins of the distal three-fourths being finely serrate, converging to an acuminate apex.

The present series of specimens yield the following measurements, expressed in millimeters:

TEST:		PRIMARY SPINES:	
<i>Horizontal Diameter</i>	<i>Vertical Diameter</i>	<i>Length</i>	<i>Width</i>
35	28.2	47-45	2.8
38	28	56-58	3, 2.7
38	26	56-54	2.5-2.8
36	50	53 Broken	3
33	48	50	2.7
33	45	55	2.5
39	45.5	45 Broken	2.5
37	48	54	2
18	24	48	2.5

TEST:

Horizontal Diameter	Vertical Diameter	PRIMARY SPINES:	
		Length	Width
24	34	47	2.2
32	52	55	2.8
38	50	55	3
30	50	44	2
30	45	48	2.5
31	43	76	2.8
37	50	56	2.8
26	42	46	2.1
35	50	50	2.5

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Cidaris abyssicola, MORTENSEN, TH., Echinoidea Deutsche Sud-Polar Exped., 1909, p. 54; Monogr. of Echinoidea, pt. I, Cidaroida, 1928, Copenhagen, p. 301, pl. 31, figs. 11-14, pl. 33, fig. 4. (Complete references and discussion).

Group: *Stylocidarina*

Genus: *EUCIDARIS* Pomel

Eucidaris metularia (Lamarck)

✓

Plate 64

TYPE: Lamarck's first record of this species referred to the much older *Echinometra muscosa amboiensis* Seba Mus. 3, t. 13, fig. 10, also fig. 11 (*Locupletis-sinus rerum naturalium thesauri* etc., Amsterdam, 1734-65) and stated:

"Habite l'ocean des Grandes Indies, les cotes de l'Ile de France celle de Sainte-Dominique, Mon cabinet. Elle est voisine de la precedente, mais distincte." (Reference is made to *Cidarites tribuloides*, to which species his specimens obviously belong.)

DISTRIBUTION: This small urchin is well known throughout the oriental tropics, from the Red Sea southward on the east coast of Africa to Zanzibar and Mozambique and eastward through the



Eucidaris metularia (Lamarck), upper figure, actinal surface, $\times 1$;
lower figure, abactinal surface, $\times 1.5$, of specimens from
Pearl Harbor, Oahu, Hawaii, in 2 fathoms.

Pacific to the Fiji, Marshall, Gilbert and Hawaiian Islands, Guam, Laysan and Palmyra Islands, and also throughout the northern coast of Australia, the Malay Archipelago, Macclesfield Bank, the Bonin Islands and Japan. Although it is principally a dweller in the littoral zone, being found abundantly on the reefs, tidepools and among the coral heads, it is also found in deep water down to about 300 fathoms. Messrs. Agassiz and Clark had a series of 296 specimens taken by the "Albatross" dredgings of 1902 in Hawaiian waters, the vicinity of Laysan and off French Frigate Shoal in bathymetric range of 13 to 319 fathoms, and temperature extremes of 78.9 to 67 degrees.

MATERIAL EXAMINED: Four specimens taken in Pearl Harbor, Oahu, Hawaiian Islands, in two fathoms, December 14, 1928.

COLOUR: Deep-water specimens reddish to purplish brown; young, brighter than older forms; The primaries are purplish brown with three or four white rings. The median interambulacral space and some of the scrobicular spines are pearly white, contrasting sharply with the dark background. The apical system is light, or white, or entirely dark, or sometimes with the dark plates strikingly margined with white lines between them.

TECHNICAL DESCRIPTION: This species has been exhaustively analyzed with exquisite illustrations of both larval and adult forms by Dr. Theodore Mortensen (1921 and 1928).

Metularia is the only one of the five members of the genus *Eucidaris* Pomel known from the great area of the Indo-Pacific region. This species is quite small in comparison with the common species of the tropical and subtropical west coasts of the Americas, or the better known *E. tribuoides* of tropical and subtropical east American waters. *Eucidaris metularia* is readily recognized by the distinctive primary spines, which are clavate, of moderate diameter for this genus, their length usually being less than the horizontal diameter of the test, thickened proximally and attaining the greatest width about one-third of the length from the proximal end, gently tapered, the shaft bearing low spinules arranged in 12 to 18 longitudinal series, these converging on the apex to outline a crown, the center of this apex being a distinct rounded knob. In the eroded apices of the primaries, especially of littoral specimens, this knob and related coronal pattern are frequently lost, the eroded apex being rounded or even subtruncate, smooth.

A second diagnostic character exists in the apical system, which is almost entirely devoid of tubercles, except for a single series of larger tubercles along the margins of the genital and ocular plates and a few small tubercles on the periproctal plates which carry one, or a very few, small tubercles each. Minute glassy beadlike warts closely pave the apical plates. The apical system is circular in outline, the oculars all being normally exsert, each plate being wedge-shaped, with convex outer margin.

The interporiferous zone of the ambulacra is slightly sunken and almost bare, this condition being another distinctive characteristic of *metularia*.

The four specimens from Pearl Harbor give the following measurements, expressed in millimeters:

TEST:		PRIMARY SPINES
<i>Horizontal Diameter</i>	<i>Vertical Diameter</i>	<i>Length</i>
21	14	8.5 to 14.5
18	13	12 " 13.5
19	14	12 " 14
13	8.5	11 " 11.5

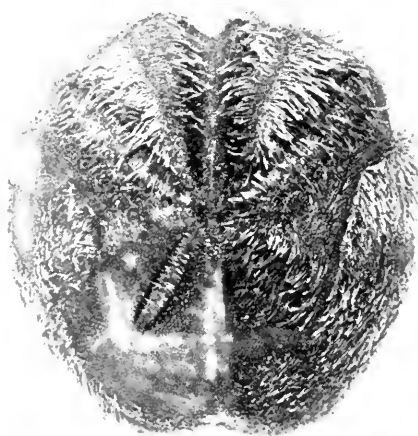
One of these specimens is shown in the accompanying plate. Excellent illustrations of the representative pedicellariae of *Eucidaris metularia* are given by Agassiz and Clark (1907), in the Memoirs of the Museum of Comparative Zoology, volume XXXIV, plate 1, figures 3 to 7.

REFERENCES: *Echinometra muscosa amboiensis*, SEBA, A., Locupl. rerum Nat. Thes., 1734-65, Amsterdam, t. II, pl. 13, figs. 10, 11.

Cidarites metularia, LAMARCK, J. B., Hist. Nat. Anim. s. Vert., 1816, t. III, p. 56; ed. II, 1840, t. III, p. 381.—DESLONGCHAMPS, E. E., Encycl. Meth., 1825, t. II, p. 195, pl. 134, fig. 8 (a reproduction of Seba's figure).

Cidaris metularia, AGASSIZ, A. and DESOR, P. J. E., 1846, Cat. Rais. des. Ech. in Ann. des Sci., ser. 3, t. VI, p. 22 (324).—DODERLEIN, L., in Wiegmann's A. F. A., Archiv. f. Naturg., 1885, Bd. LI, pt. I, p. 75.

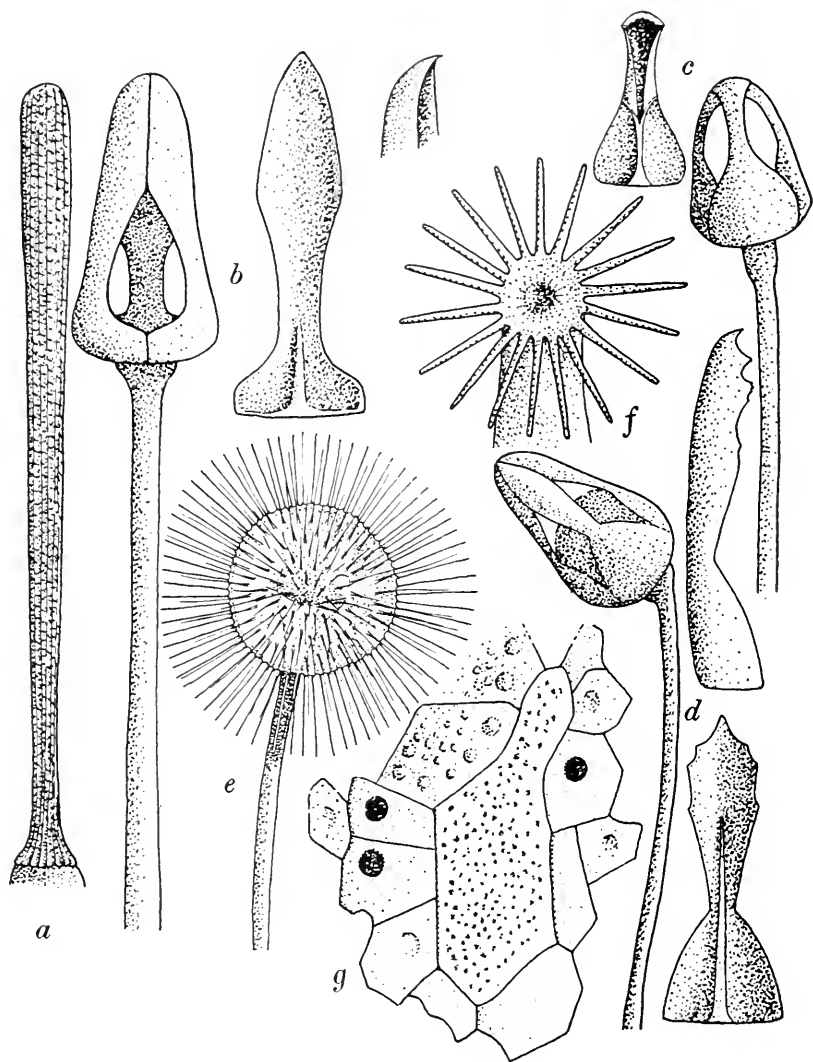
Eucidaris metularia, MORTENSEN, TH., Monogr. of Echinoidea, pt. I, Cidaroida, 1928, p. 386, pl. 41, figs. 1-8, pl. 73, fig. 6, pl. 86, figs. 11-14 (contains earlier references).



Brisaster moseleyi (A. Agassiz), $\times 1$, from Bahia de Cochamo, Chile;
actinal view, showing the labium in relation to ambulacrum III;
abactinal view, showing the relation of the petals.



Brisaster moseleyi (A. Agassiz), $\times 1.5$, from Bahia de Cochamo, Chile.
Upper figure, longitudinal profile, showing the lateroanal fasciole;
lower figure, showing the lateroanal fasciole and sternum.



Brisaster moseleyi (A. Agassiz): a, primary spine, $\times 21$; b, elongate tridentate pedicellaria as a whole, $\times 117$, one valve of same, viewed from interior, and apex of this valve in profile more enlarged; c, a small globiferous pedicellaria, $\times 117$, inner view of one valve, $\times 117$; d, large globiferous pedicellaria, $\times 117$, inner view and profile of one valve, more enlarged; e, distal portion of foot from near oral aperture, $\times 67$; f, distal portion of tube-foot expanded, from ambulacral area, $\times 67$; g, madrepores and adjacent genital plates and genital pores, also ocular plates, $\times 67$.

Order: **EXOCYCLOIDA**

Suborder: **Spatangina**

Family: **HEMIASTERIDAE**

Genus: **BRISASTER** Gray

Brisaster moseleyi (A. Agassiz)

✓

Plates 65, 66 and 67

TYPE: The type series of this characteristic Chilean species was dredged by H. M. S. "Challenger" at stations 146, 305, 307, 309, 310, also off London River, Christmas Harbor, and Kerguelen, in depths ranging from 110 to 245 fathoms. Those thirty specimens collected on the west coast of Chile, at station 305, in 120 fathoms, station 309, 40 to 140 fathoms, station 310, 400 fathoms, and station 311, 245 fathoms, all mud bottom, are in the British Museum of Natural History; the remainder are in the Museum of Comparative Zoology, Cambridge, Massachusetts, and one of these, the specimen from off London River, Kerguelen, depth 110 fathoms, has since been made the type of a distinct species, *Brisaster kerguelensis* H. L. Clark, seven more specimens of which, from the same locality, are in the British Museum (*vide* Clark, 1925).

DISTRIBUTION: In addition to the "Challenger" records for this species, *Brisaster moseleyi* A. Agassiz, it has since been taken by the United States Bureau of Fisheries Steamer "Albatross" at seven stations off southern Chile: in the western entrance of the Strait of Magellan, off Queen Adelaide Island, near Cambridge Island, off Campana Island, Taytao Archipelago, and near Valdivia in a bathymetrical range of 61 to 677 fathoms. The "Alva" station in Reloncavi Inlet, Bahia de Cochamo, Chile, adds another locality for this interesting Echinoid.

MATERIAL EXAMINED: Seven specimens, dredged in Reloncavi Inlet, Bahia de Cochamo, Chile, depth 7 fathoms, February 16, 1935.

TECHNICAL DESCRIPTION: Horizontal long diameter 61 millimeters, width diameter where greatest about at the center, 55 millimeters; vertical diameter where highest about at the apex of the abactinal system, 37 millimeters. Abactinal system 41 milli-

meters behind the anterior margin. The test is very fragile, oval, wider anteriorly, the sides low but with the abactinal surface very gently elevated posteriorly, attaining the greatest height at about the center of the apical system, behind which point it slopes briefly to the rather abruptly truncate posterior area. The abactinal system is slightly posterior to the center of the long diameter. The madreporite, of irregular shape and perforated with more than a hundred apertures, has a narrowed portion extended anterior to the apical center and obliquely toward the right lateral petal but the major portion of the madreporite extends posteriorly, more to the right than central and is irregularly suboval, with the posterior margin subtriangular and separates the posterior genital and ocular plates. Three genital pores are present, one on the right side near the anterior of the wider part of the madreporite and two on the left side, near to each other, and the anterior one is about opposite that on the right side. (Plate 67, fig. g). There is a rather deep notch in the frontal margin caused by the frontal ambulacrum. Petal III is 40 millimeters long and 9 millimeters wide anteriorly, moderately sunken; distally it is sunken into the frontal margin, incising this and with the depression extending almost to the narrowed, projecting labium. The anterior paired petals II and IV are divergent, as shown in plate 65, shallow, distally rounded, each being 32 millimeters long and about 6.5 millimeters wide near the tip. The short posterior paired petals, I and V, are not quite five-eighths as long as the preceding pairs, II and IV, being only 17.5 millimeters long and quite shallow. The peripetalous fasciole is very distinct, quite narrowed and sinuate, but wider than the lateroanal fasciole, which is traceable in its entire course in the three largest specimens but is somewhat indistinct on the smaller ones in the lateral portion. The sternum, from the tip of the labium is 45 millimeters long and about 15 millimeters wide, closely covered with smallish tubercles; in the larger specimens it is definitely keeled, as well as projecting. (Plate 66).

The spines are of two kinds; one of the larger kind, which are most abundant along and overarching the petals, have the pattern shown in plate 67, figure a, the collar being striated, the shaft being smaller proximally, subcylindrical, gradually dilated and laterally compressed distally, with the apex widely rounded, the distal portion being spatulate; there are eighteen to twenty longitudinal ridges, each composed of fine asperities, extending the

entire length of the spine; the collar is also striated. The smaller spines, forming the fasciole, are not quite one-fifth as long as the large spines and are exceedingly slender, usually pointed distally; they are also longitudinally ridged with fine asperities in series.

Pedicellariae of three kinds were found, the elongate tridentate type, shown in plate 67, figure b, which are moderately numerous on the abactinal system, also about the peristome and periproct. The interior of the valve of this tridentate pedicellaria has a median septum proximally, the lateral-distal margins are non-dentate except for a single beak-like apical hook or tooth, as shown in figures b and c. The second type of pedicellaria, shown in figure d, the large globiferous pedicellariae, which are much less abundant than the other two kinds, are to be found quite numerous around the peristome. These stout forms are 1.6 times as long as wide proximally, with the proximal half within the valves filled by the gland; each valve has the proximal inner chamber divided by a median longitudinal septum; the narrow distal portion of the valve is coarsely serrate, there being a strong apical tooth, on either side of which there are two coarse triangular teeth near the apical and a third distinct but smaller tooth, about as far below the second tooth as the latter is from the apical tooth. The inner surface of the distal portion is concave, devoid of any inner aperture. The small globiferous pedicellariae, which are moderately numerous, especially within the petaloid depressions, are not quite two-thirds as large as the large globiferous pedicellariae and are about 1.4 times as long as wide, broader apically in ratio to their size than are the large type and with different kind of valves. These valves, shown in figure c, have the wider proximal portion of the valve divided internally by a median septum which is distally bifurcate; the apical portion of the valve curves inward, the distal margin being wide, rounded, somewhat like a broad spoon, this distal-apical margin bearing six serrate teeth of moderate size.

In one of the smaller specimens of the present series ambulacrum III is so very deeply sunken and the labium narrowed and projecting that the peristome approaches a vertical instead of the usual horizontal position it occupies in the larger specimens of this series.

REFERENCES: *Schizaster moseleyi*, AGASSIZ, A., Rept. Sci. Results Voy. H. M. S. "Challenger" Zool., 1881, vol. III, pt. IX, p. 203, plate 36, figs. 14-16. (Listed on plate as *S. philippi*, vide Clark, 1925).

Schizaster (Brisaster) moseleyi, MORTENSEN, TH., Danish "Ingolf" Exped., 1907, vol. IV, pt. II, Echinoidea, p. 123.

Brisaster moseleyi, CLARK, H. L., Mem. Mus. Comp. Zool., 1917, vol. XLVI, p. 184, pl. 155, fig. 5, pl. 156, fig. 4; Cat. Recent Sea-Urchins, Brit. Mus. Nat. Hist., 1925, p. 208.

Holothuroidea

Order: ACTINIPODA

Family: HOLOTHURIIDAE

Subfamily: Holothuriinae

Genus: HOLOTHURIA Linné

Holothuria impatiens Forskal

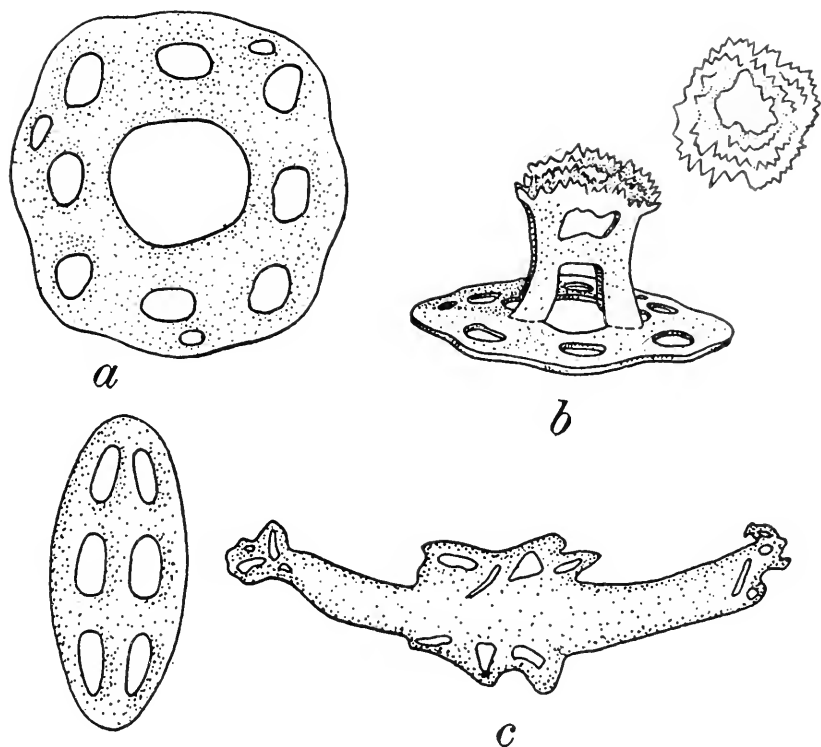
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TYPE: Forskal's type came from the shores of the Suez Canal, under stones and in certain sponges and is deposited in the Zoological Museum at Copenhagen.

DISTRIBUTION: This species, considered by some writers to be tropicopolitan in the Indo-Pacific and Atlantic Oceans, is believed by other workers to contain more than one species and consequently to be in need of critical revision. For this reason the present writer makes no attempt to give detailed distribution of the species (*sens. lat.*) which is reliably known from the Suez Canal eastward, to the Torres Straits, Hawaiian Islands and Society Islands.

MATERIAL EXAMINED: Three large and one small specimen, taken under stones on coral reef at Falcon Island, Palm Islands, Queensland, October 7, 1931, by the "Alva."

DISCUSSION: The Falcon Island specimens, which are in a state of extreme contraction, conform with the essential anatomic features described by Forskal, Fisher and H. L. Clark, respec-



Text figure 9.—*Holothuria impatiens* Forskal: a, upper figure a typical table, lower figure a typical button; b, profile of table showing spire, also crown of spire; c, rod, from papilla; all greatly enlarged.

tively. The largest specimen measures almost nine inches long in the contracted state. The general form of the living animal is said to be subcylindrical, wider posteriorly, elongate, with the dorsal and ventral surfaces apparently not well distinguished. The mouth is terminal, small, with eighteen to twenty closely crowded tentacles. The anal region is also terminal, devoid of calcareous teeth. The peristome is wrinkly with a very characteristic texture, being roughened by the spires of the calcareous tables. The ambulacral appendages are pedicel-like "papillae" borne on coarse verrucae, usually much lighter than the balance of the peristome, rather regularly distributed but not in series. They have a terminal plate. The deposits consist of tables and buttons; these tables being so closely crowded that the margins

of the disk touch or slightly overlap and beneath these buttons form a crowded, rather regularly distributed layer. The typical table consists of a nearly circular to subquadrate smooth disk, perforated by a central and seven to nine somewhat smaller peripheral holes; the spire is composed of four upright rods and two transverse beams; the rounded summit is beset with numerous teeth. The disks average 0.8 to 1.0 millimeter diameter; the spire is robust, being 0.1 millimeter high and 0.05 millimeter in diameter. The buttons are suboval in contour, about 1 millimeter long, smooth, with the wide margins undulate and the narrowed end obtuse. Six irregular subcircular to oval holes perforate the surface in fairly regular arrangement. The papillae have supporting rods which are somewhat curved or bowed with the middle area dilated and perforate and the tips or ends sometimes but not always perforated. The dilated middle area of the rod sometimes has two or three short separate branches, occasionally these anastomose, enclosing perforations. The calcareous ring has the radial pieces larger and projecting farther forward than do the inter-radial pieces. The latter each bear one short tooth. The madreporic canal is placed on the right side of the mesentery and is single and free for its whole length in the body cavity. The Polian vesicles are two to four. The Cuvierian organs form a comparatively large bunch.

The colour has been described variously by different writers, but the comparatively recent colour plates given by Dr. H. L. Clark, made from living animals at Torres Straits, are undoubtedly most reliable. These figures show the peristome mottled cream, tan and brown, with the papillae and adjacent areas usually of the darker brown tones. The tentacles are creamy white. The present alcohol-preserved specimens show the verrucae faded creamy-tan, the remainder of the peristome maculated purplish tan.

REFERENCES: *Fistularia impatiens*, FORSKAL, P., Descript. Anim., Avium, Amphiborum, Piscium, Insectorum, Vermium; que in itinere orientali, 1775, Hauniae, p. 121, pl. 39, fig. B.

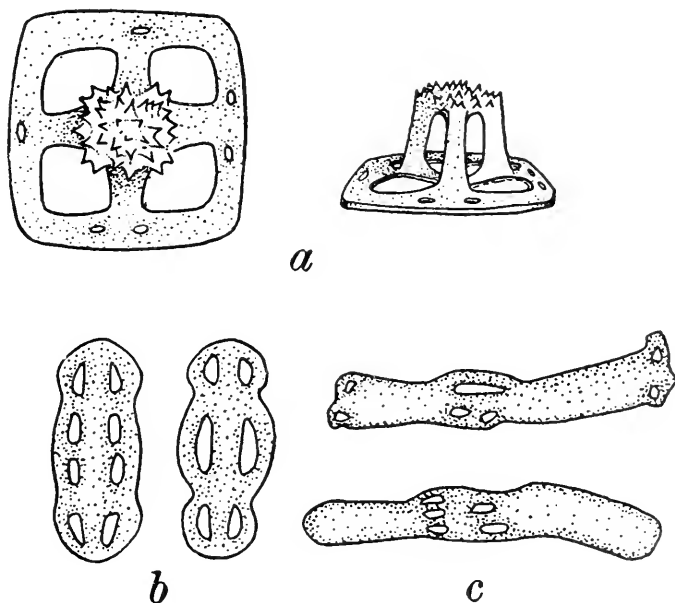
Holothuria impatiens, GMELIN, J. F., in Linné C., Syst. Nat., ed. XIII, 1788, p. 3142.—THEEL, H., Rept. H. M. S. "Challenger" Zool. Holothuroidea, Part II, 1885, vol. XIV, pp.

185, 233 (with extensive synonymy and distribution).—LAMPERT, K., *Die Seewalzen*, 1885, p. 65.—SLUITER, C. PH., "Siboga"-Expeditie, *Holothurien*, Monogr. XLIV, Livr. I, 1901, p. 9.—FISHER, W. K., *Proc. U. S. Nat. Mus.*, vol. XXXII, 1907, p. 666, pl. 69, figs. 4-a-d.—CLARK, H. L., *Publ.*, 214 Carnegie Inst., Washington, 1921, p. 178, pl. 19, figs. 3 and 5 (colour).

Holothuria arenicola Semper

1

TYPE: Semper's type material came from Bohol, Philippine Islands. In his original description he also reported occurrence of the species at Amboina (von Martens, Rosenberg), Fiji Islands (Graffe) and Surinam (Salmin). Semper's type series is probably deposited in the Hamburg Museum.



Text figure 10.—*Holothuria arenicola* Semper: a table, from above, showing crown of spire and table in profile; b, two predominant forms of buttons; c, a typical supporting rod, from a dorsal pedicel; all greatly enlarged.

DISTRIBUTION: This species is widely spread in the tidal zone of the Indo-Pacific from Kosseir, in the Red Sea through the Indian Ocean at Mauritius and Zanzibar and in the tropical Pacific in the Philippines, Torres Straits, Bonin and Marshall Islands, Amboina, Rotti, Sula Besi, Fiji Islands, Samoan Islands, Tahiti, Society Islands, Hawaiian Islands, Cocos Island and Galapagos Archipelago. It has been reported from the tropical shores of the Atlantic Ocean at Bahia, Brazil and Surinam. Dr. H. L. Clark questions the correct identity of these South American specimens.

MATERIAL EXAMINED: Two smallish specimens, from Apia, Samoa, September 5, 1931, collected by the "Alva."

COLOUR: The living animal has the body colour creamy whitish, with well scattered spots of reddish brown and five or six well separated longitudinal whitish bands.

TECHNICAL DESCRIPTION: The living animal is elongate, sub-cylindrical, with the dorsal surface arched, the ventral surface less so, both ends blunted, the mouth ventrally inclined, small; the tentacular circle is surrounded by an inconspicuous collar bearing small papillae. The tentacles are very small (very retracted in the dead specimens), twenty in number. The anus is distal, margined by annular groups, each consisting of four to six short papillae. The ambulacral appendages are represented by irregularly scattered pedicels, those of the two ventral ambulacra being larger and more numerous than those of the dorsal surface. The peristome is of medium thickness. The deposits are of two types, "buttons" and tables. The tables consist of an annular disk, quadrate-circular in outline, having a very large central hole and normally, four smaller holes, one placed at the base of each rod of the spire, (some tables exceed this arrangement, having as many as six small holes); the spire is composed of four upright rods, one transverse bar and a denticulate crown with twenty to thirty-six teeth. The "buttons" are rather regularly shaped, oval with the circumference undulating, the surface smooth, the perforations occurring in the wider radius of the button, usually six, sometimes eight. The rods in the pedicels are smooth, dilated at both ends and in the middle and also having several perforations here. The calcareous ring is small, the radialia are nearly as wide as long and are truncate anteriorly

with a small, obtuse incision, the posterior margins are slightly excavate. The interradiar pieces are much smaller than the radial; anteriorly each has one tooth, the posterior margin is conspicuously excavated. There are two Polian vesicles present in one specimen and a double madreporic canal. Cuvierian organs are absent.

REFERENCES: *Sporadipus (Alcolpos) maculatus*, BRANDT, J. F., Prodom. descript. anim., 1835, p. 46.—LAMPERT, K., Die Seewalzen, 1885, p. 73.

Holothuria arenicola, SEMPER, C., Reisen im Arch. der Philippinen Wissensch. Resul. I, Holothurien, 1867, p. 81, pl. 20, pl. 30, fig. B, pl. 35, fig. 4.—THEEL, H., Rept. Voy. H. M. S. "Challenger" Zool., Holothuroidea, pt. II, 1886, vol. XIV, p. 222.—FISHER, W. K., Proc. U. S. Nat. Mus., vol. XXXII, 1907, p. 662, pl. 68, fig. 95.—CLARK, H. L., Publ., 214 Carnegie Inst., Washington, Dept. Marine Biol. Papers, vol. X, 1921, p. 173.
Holothuria maculata, SLUITER, C., PH., Siboga-Expeditie Holothurien, Monogr. LXIV, Livr. I, 1901, p. 9.

Genus: ACTINOPYGA Bronn

Actinopyga mauritiana (Quoy and Gaimard)

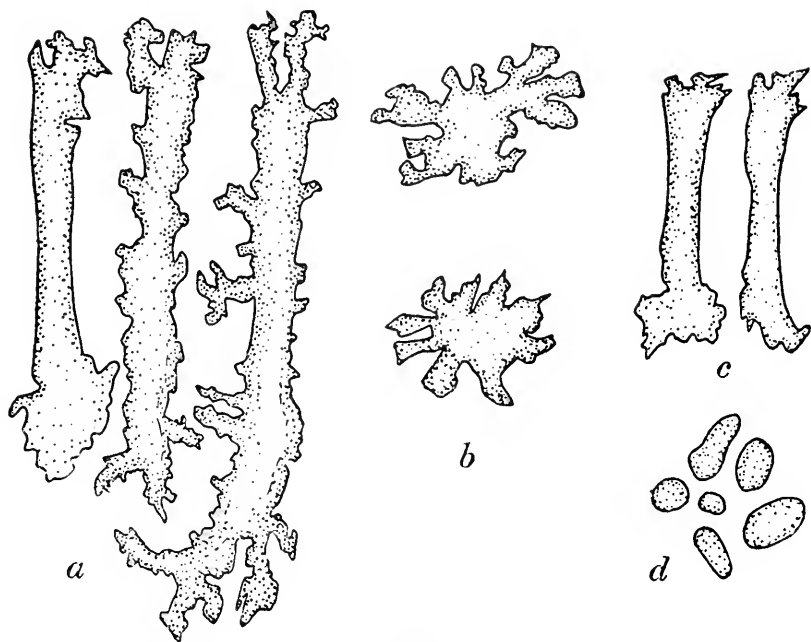
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DISTRIBUTION: This species is very abundant and widely distributed in the tidal zone of the Indo-Pacific, having been reliably reported from the Red Sea southward to Mozambique, northward to the Riu Kiu Islands, Japan, eastward to the Hawaiian Islands in the north central Pacific and to the Marquesas Islands, Society Islands and Paumotu Archipelago in the south.

MATERIAL EXAMINED: Nine large and two small specimens from Venus Point Reef, Tahiti, Society Islands, August 15, 1931.

These "Alva" specimens appear to be the second record of this species from the Society Islands.

COLOUR: Dr. W. K. Fisher records that many specimens of *Actinopyga mauritiana* (Q. and G.) which he examined in the Hawaiian Islands vary considerably in shades of brown and the amount of white present. The usual form is coloured a rich raw



Text figure 11.—*Actinopyga mauritiana* (Quoy and Gaimard): a, typical forms of rods from dorsal perisome; b, typical small rods from dorsal perisome; c, typical rods from ventral perisome, and d, granules from the same; all greatly magnified, about $\times 700$.

umber. Another specimen was unspotted, deep olive brown dorsally, light pinkish brown ventrally, with the tube-feet raw umber and the tentacles greenish brown, or translucent raw umber, with grayish effects in some lights. Another Hawaiian specimen was light olivaceous brown dorsally, decidedly blotched with white on the sides and with all the dorsal papillae ringed with white.

The Society Islands specimens have regrettably lost their living colouration and in the preserved state are all a rich mahogany brown.

HABITAT: Dr. Fisher records this species as abundant in the lava rock tidepools of Hawaii and apparently not seeking concealment, but not to be found in the coral reefs there.

The "Alva" specimens from Tahiti were all found in the coral reef zone of Venus Point Reef.

TECHNICAL DESCRIPTION: The living animals are quite large, elongate, usually somewhat constricted anteriorly and widest pos-

teriorly. The mouth is definitely ventral, bordered by a conspicuous papillose collar. There are 24 to 26 closely crowded, widely peltate tentacles, with the crests arranged in two approximately concentric series, the ampullae long. The peristome is wide, conspicuous. The pedicels are restricted to the flattish ventral surface and are packed closely together without definite arrangement. The dorsal papillae are irregularly distributed and of about the same size as the pedicels, but much less numerous. They are more crowded and larger along the lateral margins of the dorsum, adjacent to the pedicels and also near the anus. The peristome is tough, leathery, with two types of deposits in the dorsum, namely longer and shorter rods which have their ends dichotomous or spinose and their lateral walls with small spinose or blunted processes. Scattered among these are many small multibranched rosettes. On the ventral peristome the deposits are very characteristic, forming several layers. They consist of numerous small, oval grains and of larger simple rods with the ends roughened. The rosettes are sparsely represented in the ventral peristome. The calcareous ring is heavy. The radialia and interradialia are of nearly the same size. There are two Polian vesicles present and two to three madreporic bodies; these lie to the left of the dorsal mesentery, free in the body cavity. Cuvierian organs are present. The right respiratory tree is twice as long as the left one, reaching to the calcareous ring. The left tree is more thickly branched.

REFERENCES: *Holothuria mauritiana*, QUOY AND GAIMARD, Voyage de Astrolabe Zoologie, Zoophytes, T. IV, 1833, p. 138.—BRANDT, J. F., Prodrum. Descript. Anim. ab H. Mertensio Observ., 1835, p. 54.

Mulleria mauritiana, SEMPER, C., Reisen im Arch. der Philippinen Wissensch. Resul. I, Holothurien, 1868, p. 76.—THEEL, H., Rept. H. M. S. "Challenger" Zool., Holothuroidea, pt. II, 1885, vol. XIV, p. 201.—LAMPERT, K., Die Seewalzen, 1885, p. 98; Zool. Jahrb. Bd. IV, 18—, p. 83 (with synonymy).—SLUITER, PH., Siboga-Expeditie Holothurien Monogr. XLIV, Livr. I, 1901, p. 24.

Actinopyga mauritiana, BELL, F. J., Sci. Trans. Royal Dublin Soc., ser. II, vol. III, 1887, p. 653, pl. 39, fig. 1.—FISHER, W.

K., Proc. U. S. Nat. Mus., vol. XXXII, 1907, p. 648, pl. 67, figs. 1, 1a-d.—CLARK, H. L., Publ., 214, Dept. Marine Biol., Carnegie Inst., Washington, D. C., 1921, p. 188.

Genus: *STICHOPUS* Brandt

Stichopus horrens Selenka

✓

Plate 68

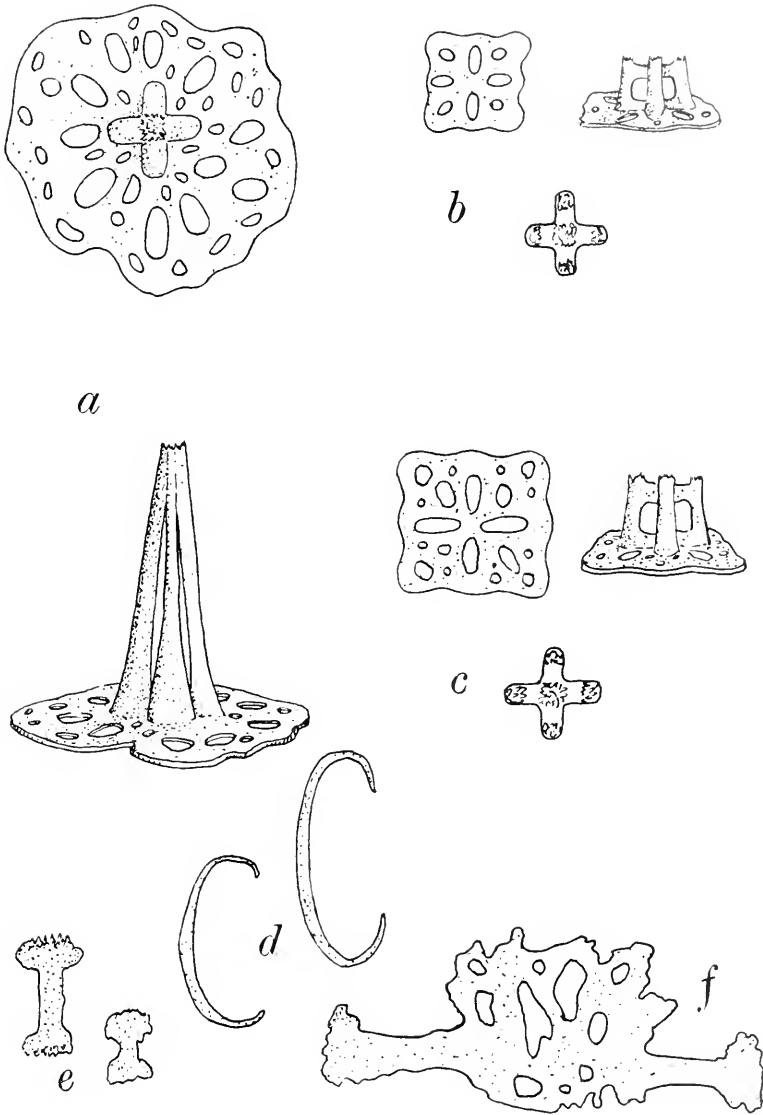
TYPE: The type was collected in the Society Islands and is deposited in the Leipzig Zoological Museum.

DISTRIBUTION: This species has been recorded from the littoral zone of the South Pacific, at the following places: Cebu, Philippine Islands (Lampert, Fisher); Mer and Erub, Torres Straits (H. L. Clark); Pelew Islands, Samoan or Navigator Islands, Tonga Archipelago, Fiji Archipelago (Semper, Theel); Sandwich Islands (Theel); Hawaiian Islands (Fisher); Society Islands (Selenka, Boone).

MATERIAL EXAMINED: One very large specimen, taken on Venus Point Reef, Society Islands, August 15, 1931.

COLOUR: Dr. Hubert L. Clark has given an excellent colour plate of this species made from living holothurians in Mer and Erub, Torres Straits (1921, pl. 18, fig. 4). The colour pattern is an indescribably variable mottled combination of brown, blackish-gray and white with occasionally olive green. Dr. Fisher (1907) found Hawaiian specimens dominated by olive green and brownish-green. The smaller living specimens are very pellucid, a factor which greatly increases their protective colouration.

TECHNICAL DESCRIPTION: The single specimen taken by the "Alva" is very contracted but measures 16 inches long. The general form of the living holothurian is elongate-subcylindrical, not visibly tapered anteriorly but moderately tapered and truncate posteriorly; dorsally arched and ventrally flattened. The mouth is large, ventral, anterior, surrounded by a fringed papillose collar. There are twenty tentacles, each of which is rather short, broad, peltate, with a convex crown. The peristome of living specimens is characterized by conspicuous, coarse, conical, mammiform



Stichopus horrens Selenka: a, disk of large table and table in profile, showing spire; b, disk, profile and crown of smaller table, from the dorsal perisome; c, another small table from dorsal perisome, disk, profile and crown; d, C-shaped rods; rods from dorsal perisome; f, supporting rod, from ventral pedicel; all greatly magnified.

protruberances in which are embedded numerous tabular deposits, the spires of these tables rendering the surface of the integument rough. The collar near the margin has numerous robust papillae which are slightly smaller than the above described protruberances. In the ventral surface the pedicels are numerous, arranged in three longitudinal bands, the median of which is about twice as wide as either lateral band. On the dorsal surface the papillae are scattered, there being four irregular approximate longitudinal series of very coarse protruberances, namely, one each on both dorsal ambulacra and one very irregular series on either side adjacent to the ventral surface. The apex of the verrucae each terminate in a papilla. Smaller papillae are scattered over the interambulacra, about 5 to 10 millimeters apart.

The deposits consist of four types: (a) Large, stout tables with a broad basal disk of irregular margin and having one diameter longer than the other; this disk being perforate with irregular shape, subcircular to suboval holes of various sizes; the disk supports a well developed tapering spire, with two or three cross pieces and terminating in a single or, more rarely, two or three points. (b) The smaller tables are found in both dorsal and ventral peristome and are about one-half of a millimeter high. They are of varying size. The disk is small, subquadrate with irregular marginal contour, usually four peripheral large holes at the base of the spire supports and with a truncate spire, terminating in 8 to 16 small, sharp teeth. (c) The third type of tables is similar to the second but is larger and has a much higher spire, also more numerous perforations near the circumference of the disk. The third type of deposit consists of dichotomously branched rods, forming small, somewhat imperfect rosettes, scarcely a half of a millimeter long, abundant in the dorsal peristome but rare in the ventral. (d) The fourth type of deposits is the small C-shaped bodies, from 0.1 to 0.2 millimeters long, scattered throughout the entire integument.

The calcareous ring is well developed in the present specimen and has the radial pieces decidedly larger than the interrarial; anteriorly the border has four blunt points, posteriorly, two longer ones. Each radial piece has a single point anteriorly and posteriorly the margin is concave.

Two Polian vesicles are present, normally developed. The madreporic canal is single, situated in the dorsal mesentery.

REFERENCES: *Stichopus horrens*, SELENKA, E., Zeit. f. Wiss. Zool., Leipzig, 1867, Bd. XVII, p. 316, pl. 18, figs. 27-29.—CLARK, H. L., Papers Dept. Marine Biol., Publ., 214, 1921, Carnegie Inst., Wash., vol. X, p. 187, pl. 18, fig. 4 (colour).

Stichopus godeffroyi variety B., SEMPER, C. G., Reisen im Archipel. de Philippinen Wiss. Resul. Holothurien, 1868, Bd. I, Theil II, p. 246, Leipzig.—THEEL, H., Rept. Sci. Res. Voyage H. M. S. "Challenger" Zool., 1885, vol. XIV, p. 168, p. 196, pl. 7, fig. 8.

Stichopus tropicalis, FISHER, W. K., Proc. U. S. Nat. Mus., 1907, vol. XXXII, p. 676, pl. 70, fig. 1a-i.

Family: CUCUMARIIDAE

Genus: PENTACTA Goldfuss

Pentacta arae, new species

✓

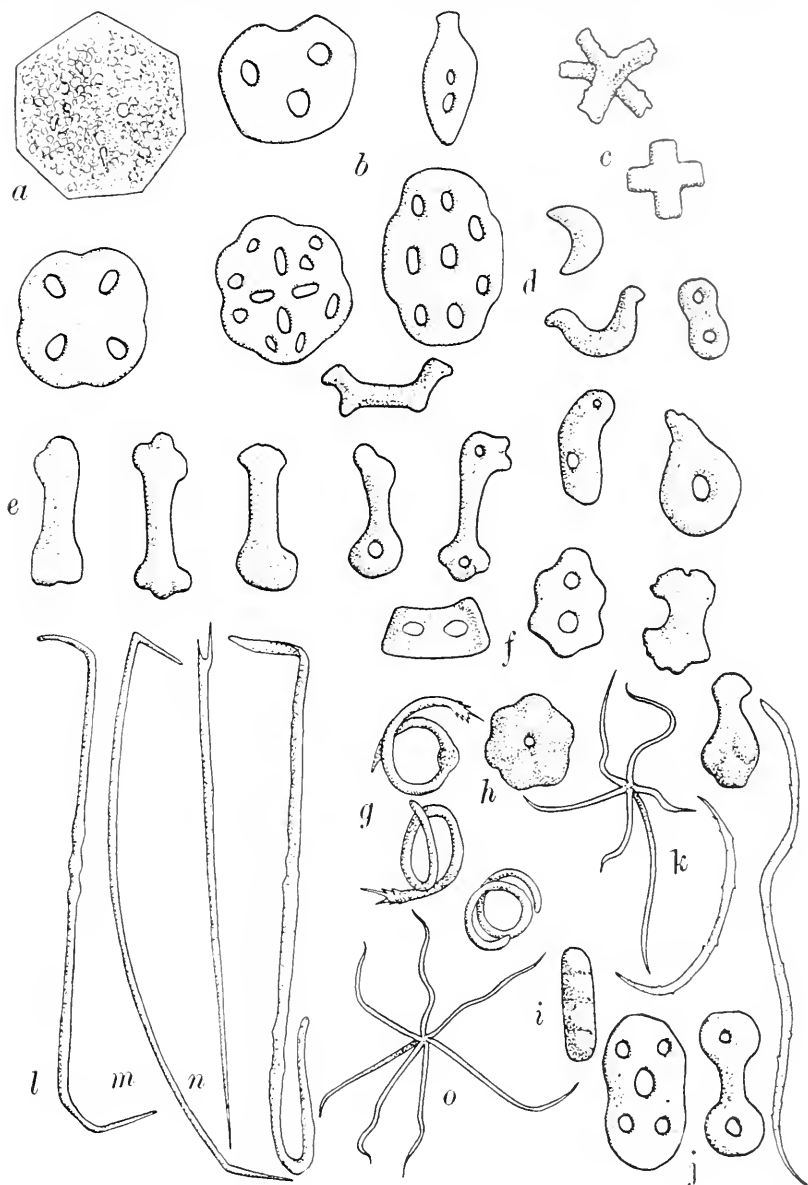
Plates 69 and 70

TYPE: Two specimens were taken by the "Ara," the smaller one at the mouth of the Saigon River, Cochin China, in eleven fathoms, and the larger one in seven fathoms, at Southwest Bay, Pulo Condore Islands, South China Sea, February 4, 1929. These are deposited in the Vanderbilt Marine Museum.

TECHNICAL DESCRIPTION: The smaller specimen (alcohol preserved) is about 75 millimeters long diameter and 55 millimeters maximum short diameter, which occurs approximately midway the length. The body is distinctly unequal ovoid, globular, with the oral and aboral apertures definitely dorsad. The ventral surface, which is occupied by the three ambulacra of the trivium, appears to be distinctly wider than the dorsal surface bounded by the bivium. There are five valves at the anterior extremity. Ten tentacles are present, the two ventral ones being a little smaller than the others. The calcareous ring is composed of five simple pieces. The pedicels are numerous on the ambulacra of the trivium. On the upper two of the ventral ambulacra, the pedicels persist almost to the orifice in much reduced form, those of about the first eight pairs being more widely spaced from each other and irregularly scattered in somewhat alternate series, on the anterior



Pentacta arae Boone, type, $\times 1$, profile view.



Pentacta arae Boone, type: spicules from tissue from the median ventral surface near the intermediate ambulacrum: a, hexagonal thin scale from outer layer of bodywall; calcareous deposit from inner layer of bodywall: b, circular and oval disks, variously perforate; c, crosses with four- and six-arms; d, crescents and crescentlike bodies with double curve; e, clavate perforate and non-perforate rods; f, i, rodlike bodies with four transversely banded lobes; l, convolute needlelike spicule with curved ends.

Spicules from tissue from the median dorsal surface of body: needlelike spicules; m, bow-shaped spicules, with subdistal bend of both apical portions; n, straight spicule with one end bifurcate and elongate spicules tri- or quadrisinate, with both apices bent or curved; o, six- and seven-rayed anchor spicules; g, spiral spicules of three kinds; f, clavate irregular bodies; h, disks; j, clavate and oval perforate disks; k, C-shaped and convolute spinose spicules.

Figures a, b, c, d, and e, magnified, $\times 43$; f, h, i, j, k, l, m, n, o, magnified, $\times 65$.

tenth of the ambulacrum, posterior to which point the pedicels become closely crowded together, continuing for three or four pairs in alternately placed dual series, then abruptly widening to four pedicels to each transverse series, these placed in close-set alternate arrangement for about eight series of four pedicels each, these being succeeded by six pedicels per transverse series, which arrangement persists for the next three-eighths of the length of the ambulacra, thence decreasing to four pedicels per transverse series, for the space of five or six rows, these being followed by an alternate placed dual series of twelve to fourteen pairs, those pedicels toward the aboral end being less distinct, more widely separated, the most posterior pair being a little distance (about 5 millimeters) from the aboral aperture. The median ventral ambulacrum of the trivium is like the submedian pair of ambulacra, but has the pedicels persist in transverse series of four per each row nearer to the oral end than do those of the lateral pairs; there being only eight pairs of dual series of pedicels and these placed closer together in more nearly regular series on the ventral ambulacrum. Posterior to these eight pairs in dual series, the arrangement of four pedicels per transverse series persists for only six or seven rows, these being replaced by the fairly large, closely crowded pedicels, in transverse series of six alternately placed pedicels, which continues for nearly half the length of the ambulacra and is followed posteriorly by about eighteen rows composed of four pedicels each, in rather close formation, these quadri-series of pedicels extending much further posteriorly than do those of the outer pair of ventral ambulacra, there being only five or six dual series in the median ambulacra posteriorly, the last pair of these pedicels being just a little outside of the aboral area, about in line with the most posterior pairs of the outer ventral ambulacra.

The subdorsal ambulacra, forming the bivium, have the pedicels rudimentary, papillae-like, fewer and more scattered, in approximate dual series, the papillae of a pair being widely spaced from one another as well as from adjacent pairs. Toward the median area of each ambulacrum, there is for a very brief space a few secondary, small papillae in addition to the dual series, but at no place do these attain the four per transverse series arrangement of the trivium ambulacra.

The larger specimen differs from the smaller one only in size and in the fact that the bivium is less distinctly defined, the dorsal papillae being quite small, fugitive and more difficult to locate in the alcoholic specimen.

The body-wall, a uniform chalky-white in the preserved specimen, gives no hint of the original color. It is unusually tough, leathery, brittle with calcareous deposits, and is composed of two distinct layers, the outer one being a practically continuous pavement, consisting of delicate, thin, calcareous scales, the majority being of a hexagonal pattern and some of irregular denticular shape crowded between; each scale consists of small, irregular calcareous coalescent bodies with minute interstices between, forming a pattern of continuous irregular reticulation; the scale is highly porous.

The inner wall is composed of numerous much coarser calcareous bodies of various shapes, which, however, are of three principal types: (a) clavate both perforate and non-perforated, rodlike, composed of four transversely banded lobes; (b) circular and oval disks, variously perforate with from one to twelve holes; (c) numerous small crescents and double-curved crescent-like bodies; (d) small crosses with equal arms, less frequently a sort of double-cross with six short equal arms divergent. There are also occasional long, convolute, needle-like spicules with one or both distal ends bent or curved. The above described varieties of spicules were dissected from the median ventral surface near the intermediate ambulacrum of the trivium.

A piece of tissue snipped from the median dorsal surface, when dissected, shows no disks present, but there is an intricately intermeshed spicule formation, comprised of three principal types of long, needle-like spicules; (a) straight spicules with a bifurcate, acuminate apex on one end and a single needle-point on the opposite end; (b) bow-shaped spicules with the subdistal bend of both apical portions, and (c) needle-thin, elongate spicules, tri- or quadri- sinuate with both apices curved. There are also a few anchor spicules which have six slender, somewhat unequal, curved and twisted prongs, forming an irregularly six-pointed star in one plane, with a seventh branch arising from the center of this and extending at right angles therefrom, the distal portion of this branch bent obliquely outward. Less numerous but defi-

nately a factor in this complex spicule formation are occasional slender, spiral spicules, consisting of one and a half to two or more coils, with the distal ends each furnished with a cluster of five or six slender, acuminate spines, all of which diverge obliquely outward. There are also small irregular bodies, somewhat clavate with nodes on the enlarged ends, these node articles sometimes have three branches instead of two ends. There are also small disks irregularly circular or oblong, sometimes with the margin sinuate-convex, sometimes tri-lobed, each with the surface pierced with two or three small holes.

The smaller specimen is figured in plate 69. The plate of spicules (plate 70) is based upon micro-dissections from the dorsal and ventral tissues adjacent to the ambulacra, about midway their length, from both specimens. Every kind of spicule depicted was found repeatedly in each specimen.

COLOUR: Not recorded from the living specimens.

Pentacta arae has the general appearance of the old and rather widely distributed Indo-Pacific species, *P. tuberculosus* (Quoy and Gaimard),¹ but is unquestionably distinguished therefrom by the presence of entirely different kinds of calcareous bodies in the perisome.

Order: PARACTINOPODA

Family: SYNAPTIDAE

Subfamily: Synaptinae

Genus: EUAPTA Ostergren

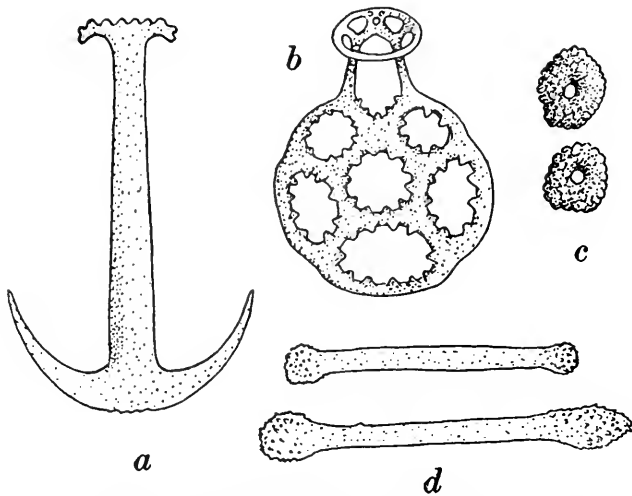
Euapta godeffroyi (Semper)

✓

TYPE: Semper's type material came from the Samoan Islands, where it was collected by Dr. Graffe. It is deposited in the Museum Godeffroy.

DISTRIBUTION: This species is known from the littoral zone of the Indo-Pacific, where it has been recorded from the following localities: Mauritius (Haacke, Ludwig); Thursday Island, Torres Strait (Sluiter) and Mer (H. L. Clark); Great Sangir Island,

¹*Holothuria tuberculosa*, Quoy and Gaimard, 1833, Voyage de L'Astrolabe. Zoologie, T. IV, p. 131.



Text figure 12.—*Euapta godefrroyi* (Semper): a, anchor; b, anchor-plate; c, miliary rosettes; d, rod from tentacle; all enlarged about $\times 185$.

Celebes (Sluiter); Pelew Islands (Bedford); Samoa (Semper, type locality); Hawaiian Islands, at three "Albatross" stations (Fisher); Kaneohe Bay, Hawaii (Boone).

MATERIAL EXAMINED: Four specimens from Kaneohe Bay, Oahu, Hawaii, depth 1 fathom at low tide, collected by the "Ara," December 15, 1928, add a fourth Hawaiian record for this species.

COLOUR: The living specimens are described by Bedford (1899) as being yellowish gray or creamy white with radii indicated by greenish brown or pale brown stripes and the dorsal inter-radii marked with large, dusky, greenish-brown blotches. The young are speckled with silvery gray.

TECHNICAL DESCRIPTION: The four alcoholic specimens measure, respectively, 320, 270, 385 and 310 millimeters long and have variously 16, 15, 16 and 16 pinnate tentacles apiece. The tentacles have from 24 to 72 pinnae each, united proximally for from a third to half their length by a delicate web.

The living specimens are slender, elongate, subcylindrical, moderately tapered posteriorly; anteriorly the disk is surrounded by fifteen to sixteen pinnate tentacles; the tentacles have twenty-four to seventy-two pinnae apiece, connected proximally for from a third to half their length by a delicate webbing. The original

colouring is lost; in alcohol, the only colouring left is a creamy white ground colour maculated irregularly with steely grayish splotches and with distinctive transverse bars of olivaceous brown on the dorsad.

Typical examples of the calcareous deposits are shown in figure 12. These are of four kinds: (a) Simple anchors, 0.5 millimeters long and 0.3 millimeters wide, with smooth flukes distally tapered, describing an arc equal to 0.6 of the length of the central shaft which terminates distally in a short bar bearing six to eight small spinules; (b) anchor plates, subcircular disks, about 0.30 to 0.27 millimeters long, with a narrowed prolongation supporting the handle; the disk pierced by seven large, somewhat unequal, subcircular or suboval holes, the seventh hole being dentate on the proximal or basal margin, the distal portion being smooth, elongated, narrowed distally, subovate and two moderately large and three or four small, smooth holes in the handle. These two large holes of the handle are symmetrically placed and are separated by the narrow apex of the seventh hole of the disk. There are normally three small, nearly equal holes in the handle. The anchors and anchor plates are very numerous in the skin; these pairs being separated from one another by an average space of one and five-tenths to twice the length of the anchor. The flukes of the anchor are not infrequently bent off their plane; (c) there are also great quantities of miliary rosettes of subcircular outline with a small, subcircular hole in the center, to be found in the skin. These rosettes are about 0.2 to 0.3 millimeters in diameter. These rosettes are especially abundant in the tissue surrounding the peristome and in the tentacles; (d) there are also in the peristome and tentacles tissues numerous straight or slightly curved rods, 0.01 to 0.03 millimeters long, with dilated ends, both the lateral surface and apices being covered with asperities.

The calcareous ring has five radial pieces, each with an anterior perforation and the related posterior margin more shallowly notched than are those of the moderately excavate interradians. The Polian vesicles are of moderately unequal length. The madreporic body is elongated.

REFERENCES: *Synapta godeffroyi*, SEMPER, C. VON, Reisen im Archipel. der Philippinen, Wissensch. Res., 1868, Theil III, Bd. I, Leipzig, p. 231, pl. 39, fig. 13.

Euapta godeffroyi, OSTERGREN, H., Ofv. K. Vet.-Akad. Forh., 1898, vol. LV, p. 113,—FISHER, W. K., Proc. U. S. Nat. Mus., 1907, vol. XXXII, p. 721, pl. 81, figs. 3a, b.—CLARK, H. L., Smiths. Contrib. Knowl., 1907, vol. XXXV, p. 72; Publ. 214, Carnegie Inst., Dept. Marine Biol., 1921, vol. X, p. 158.

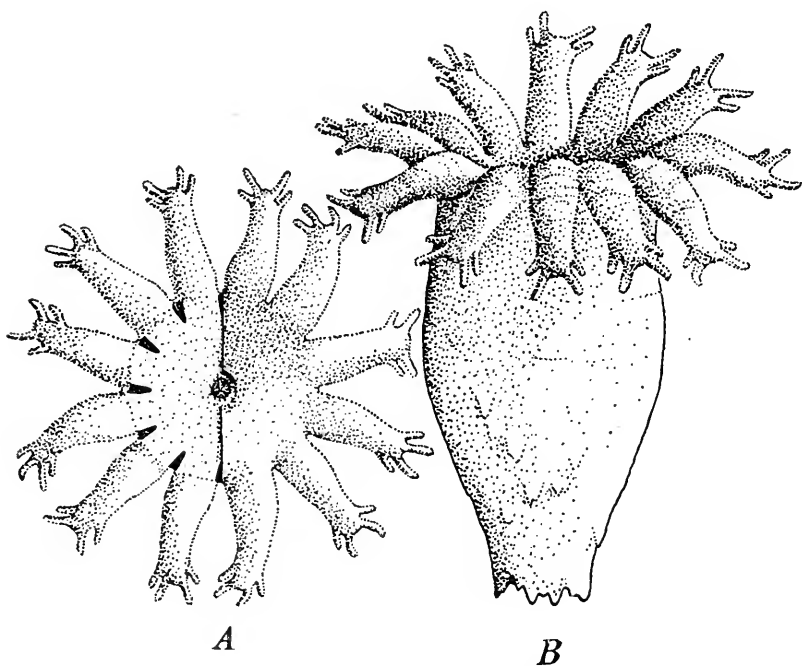
Genus: SYNAPTA Eschscholtz

Synapta species, larvae

1

MATERIAL EXAMINED: Two different larval stages of a *Synaptid* holothurian, taken in 140 fathoms, Flores Strait, near Laran-tuka Village, Flores Island, Dutch East Indies, October 22, 1931.

DISTRIBUTION: Pelagic, Dutch East Indies.



Text figure 13.—*Synapta species larva*: A, oral disk with tentacles, skin removed from left half of figure, showing fusion of tentacles with the circular canal from which Polian vesicle also arises; B, profile of *Pentacula* stage of *Synapta* larva, taken in 140 fathoms, Flores Strait.

REMARKS: Specimen A represents the *Pentacula* stage of a *Synapta*. It has the five interradial circumoral tentacles and when cut open longitudinally shows the slightly curved gut terminating in the aboral anus. The body is marked into the five radial sections, of which the dorsal two, composing the bivium, are more developed than the two lateral radii of the trivium (ventral in position), which possess nerves, muscles and tube-feet and later develop oral tentacles.

Specimen B represents a seldom seen larval *Synaptid*, in an excellent state of preservation, the oral end being expanded disk-like and showing the twelve digitate tentacles, each of which is distally quadridigitate and internally beneath the muscular disk each tentacle communicates with a tube, which converge like the spokes of a wheel, uniting in a circular ring from which also arises the Polian vesicle. These radial water canals of the larval *Synaptid* are especially interesting because they are absent in the adult.

The central aperture to the aesophagus is controlled by a strong muscular ring. The intestine is large and well filled with detritus, the lower gut being broken from the aboral aperture and extruded.

The five rays are definitely developed, but unequally so, as they are in the mature larva, specimen A.

Externally the body-wall is so constricted in the dead specimen that it appears to be a soft-textured skin continuously paved with small rounded verrucae. Posteriorly the body-wall is rounded and externally near and adjacent to the aboral aperture the body-wall is developed into slightly branched processes, resembling the pseudanchrorhagi of an actinian.

The *Synaptidae* are considered to be an early offshoot of the Holothuridean ancestor. The adult *Synaptid* has an elongated, cylindrical body with the oral and aboral apertures terminal; tentacles pennate or digitate and supplied direct from the circular canal, no radial tubes being present.

REFERENCE: GOODRICH, E. S., in Lancaster, E. Ray, editor of: A Treatise in Zoology, pt. III, 1900, chapter XIII, The Eleutherozoa-Holothuroidea, p. 234.

PART V

CRUSTACEA

PART V
SYSTEMATIC DISCUSSION
CRUSTACEA

The Crustacea presented in this Bulletin of the Vanderbilt Marine Museum, are a part of the collections obtained by Mr. William K. Vanderbilt during a series of cruises on his yachts "Ara" and "Alva" during the years 1928 to 1935. These expeditions included the World Cruise of the yacht "Ara," 1928-1929, the World Cruise of the yacht "Alva," 1931-1932, which has contributed also the Crustaceans collections reported in the Bulletin of the Vanderbilt Marine Museum, Volumes V and VI, the "Alva" Mediterranean Cruise of 1933, and the "Alva" South American Cruise of 1935. The thirty-five species herein discussed include Stomatopoda, Brachyura, Macrura, Anomura and Cirripedia.

Only two species of Stomatopoda are present, *Lysiosquilla maculata* (Fabricius) from Hawaiian waters and the very rare *Squilla gilesi* Kemp, represented by two very fine specimens from Singapore, a record which very definitely extends the southern range of this species.

The Brachyura are represented by nineteen species, ten of which are quite rare. *Raninoides loevis* Latreille from the Pearl Islands (Boone, 1930) discussed in the present volume, is of exceptional interest, since the specimens in the Vanderbilt collections definitely establish the presence in the American tropical Pacific of this rare frog-crab, hitherto known only from the tropical and subtropical east coasts of the Americas.

Calappa philargius (Linné), one of the rarest species of this interesting genus of box-crabs was taken in Singapore by the "Ara," adding a new locality for it, to the less than twenty reliable records for this exquisitely sculptured crab which has been known since 1758. The better known *Calappa hepatica* (Linné), previously described in these bulletins from material obtained by the "Alva" World Cruise in the Society Islands, was also taken by the "Ara" in Hawaii.

The spider crabs are represented by three rare, deep-water species. An exceptionally fine series of *Anasimus fugax* A. Milne Edwards dredged by the "Alva" off Sombrero Light, Florida, in

80 fathoms, includes more and larger specimens of this deep-water spider crab than are known from all previous expeditions and also establishes the most northern record for it. The second species, *Rochinia crassa* (A. Milne Edwards), is represented by two large specimens dredged by the "Alva" off Fowey Rocks, Florida, in 100 to 200 fathoms, bearing numerous *Lepad* barnacles. The larger of these crabs is one of the largest specimens known. The capture of an exceptionally fine specimen of *Stenocionops ovata* (Bell) in 45 fathoms, off the Pearl Islands, Bay of Panama, afforded opportunity to correlate Mr. Thomas Bell's species, established on a young specimen from Galapagos over a hundred years ago, with the gigantic adult crabs which more recent writers have described under various synonyms.

The family *Portunidae* is represented in the present report by four species of exquisitely colored swimming crabs, three of which are members of the genus *Neptunus*: *Neptunus pelagicus* (Linné) with its lovely jade green body delicately etched with sea-foam splashings, was obtained by the "Ara" in Manila Bay; *N. sanguinolentus* (Herbst), bearing the legendary "blood drops" of a slain Polynesian warrior, on its opalescent shell, was also taken in series by the "Ara" in Hawaiian waters and the very rare *N. tuberculosus* A. Milne Edwards, with its shell sculptured to resemble grains of sand, enhanced by a color reticulation perfecting mimicry of water-rippled sand, was caught at Aden, in the Arabian Sea. This latter species is apparently for the first time deposited in an American museum. The strikingly beautiful *Podophthalmus vigil* (Fabricius), previously reported in the crabs of the "Alva" World Cruise, was also taken by the "Ara" in Hawaiian waters.

Three species of *Canceridae* were taken. These include the barnacle encrusted east American deep-water species, *Cancer borealis* Stimpson, which was taken in series from off Fowey Rocks, Florida, in 100 to 200 fathoms, and two rare Chilean species,—*Cancer coronatus* Molina, oldest of the American species of *Cancer* and perhaps most decoratively ornamented, first described by the Abbe Don Juan Ignacio Molina, in 1787, material of which was taken by the "Alva" at Ascencion Island, Chile, enabling the writer to restore to this species its true name. Some very fine specimens of *Cancer edwardsii* Bell were taken in series at Port Lagunas and Bahia Ancud, Chiloe Archipelago, Chile.

Exceptionally interesting among the east American deep-water species discussed here is *Geryon quinquedens* S. I. Smith, dredged in 100 to 200 fathoms, off Fowey Rocks, Florida, of which the first color record is given. This rather rare species is also found in the tropical eastern Atlantic.

Two species of the *Grapsidae*, the gaily colored, gnome-like dwellers of the tropicopolitan tidal zone, were obtained by the "Ara" at Jebwar, Jaluit Island, Marshall Islands,—the discoidal, scarlet *Grapsus grapsus* Linné and the smaller *Geograpsus lividus* (H. Milne Edwards). The seldom captured *Sesarma* (*Sesarma*) *rotundatum* Hess was taken on Kusai Island, Caroline Islands, establishing a new locality for it.

Here also were taken the rare land crab, *Cardisoma hirtipes* Dana, a magnificent specimen, with the rich colors of its deep violet-purple body accentuated by the cinnabar red of the gigantic claws and the widely distributed little burrowing crab of the Indo-Pacific tidal zone, *Uca annulipes* (Latreille), legendary Chinese god of the tides, both of which species are recorded from the Caroline Archipelago for the first time.

The *Macrura* include only four species, two of which were obtained by the "Alva" Mediterranean Cruise,—the ancient, primitive *Scyllarides aequinoctalis* (Lund) previously obtained by the "Ara" in the West Indies, is represented by a large male and female with thousands of eggs, taken at Funchal, Madeira, and the spiny, sculptured *Nephrops norvegicus* Linné, one of the economically and ecologically important prawns of European seas, is recorded from Almeria, Spain.

The very rare *Peneus merguiensis* de Man, previously reported in the "Alva" World Cruise collections from Noumea, New Caledonia, was also taken by the "Ara" in 25 fathoms, in Manila Bay; the first record of the coloration of this exquisite prawn is given from Mr. Vanderbilt's field notes.

Another of the Chilean species established so long ago by the Abbe Don Juan Ignacio Molina (1787) was taken by the "Alva" South American Cruise of 1935 in Callao, Peru, the fascinating little "mason crab" (shrimp), *Palaemon caementarius* (Molina), the only freshwater species in the present report.

The *Anomura* are represented by seven species, five of which are hermit crabs, one, a *Galatheid* and one, a *Porcellanid* crab. A magnificent specimen of *Petrochirus bahamensis* (Herbst),

dredged in 45 fathoms, in the Bay of Panama, is especially interesting, being one of the Crustaceans found in the waters on both sides of the Isthmus that has not undergone changes since its elevation.

Calcinus elegans (H. Milne Edwards) is recorded from the Carolines for the first time, where an unusually fine series, including the various growth stages of the species, was obtained by the "Ara."

Pagurus cataphractus Boone, a new species of hermit, from Lahaina, Maui, Hawaii, is described and deposited in the increasing type series of the Vanderbilt Marine Museum. A second member of this genus, *P. deformis* H. M. Edwards, was taken in Zamboanga and appears to be the first Philippine material of this species deposited in any American Museum. The rare *P. varipes* Heller was also taken by the "Ara" at Lahaina, a record which very substantially extends the known range of this species from the Malay Archipelago to Hawaii.

The catch of over a hundred and forty specimens of the scarlet *Munida gregaria* (Fabricius) at several Chilean stations, from Ton Gay Peninsula to the Chiloe Archipelago, provided material sufficient to evaluate the variation existent between the different growth stages of the species, where much confusion has been.

Likewise, examination of the series of little *Porcellanid* crabs from the Chiloe Archipelago directed attention to the fact that these specimens of the "Alva" South American Expedition of 1935 are identical with M. Guerin de Meneville's type of *Porcellana granulosa* from Valparaiso, as described by him a hundred years ago, and enabled the writer to restore this name which automatically has priority over the several synonyms under which the species is better known.

The Cirripedia described include three species, the circum-tropical pelagic *Lepas anserifera* Linné found floating in the Indian Ocean, attached to the "pen" of a very rare Cephalopod mollusk and two deep-water barnacles, each of which was taken attached respectively to rare sea-urchin's spine, *Cidaris abyssicola* (A. Agassiz), from off Sand Key Light, Florida, in 65 to 100 fathoms, and a rare spider crab, *Rochinia crassa* (A. Milne Edwards), from off Fowey Rocks, Florida, in 100 to 200 fathoms, both of which species are illustrated.

The species of Crustacea discussed are distributed as follows:

Lysiosquilla maculata (Fabricius), Kaneohe Bay, Oahu, Hawaiian Islands, 2 fathoms.

Squilla gilesi Woodmason Mss., Kemp, Singapore, Malay Straits.

Raninoides loevis Latreille, Perlas Islands and West Indies, Marquesas Keys, Florida.

Calappa philargius (Linné), Singapore, Malay Straits.

Calappa hepatica (Linné), Kaneohe Bay, Oahu, Hawaiian Islands, 1 fathom.

Anasimus fugax A. Milne Edwards, 13 miles off Sombrero Light, Florida, 80 fathoms; *Poecilasma inaequilaterale* Pilsbry attached.

Rochinia crassa (A. Milne Edwards), off Fowey Rocks, Florida, 100 to 200 fathoms; *Poecilasma inaequilaterale* Pilsbry attached.

Stenocionops ovata (Bell), off Perlas Islands, Panama, 45 fathoms.

Neptunus pelagicus (Linné), Manila, Philippine Islands, pelagic.

Neptunus sanguinolentus (Herbst), Kewalo Bay, Oahu, Hawaiian Islands, pelagic.

Neptunus tuberculatus A. Milne Edwards, Aden, Amha, Arabia, pelagic.

Podophthalmus vigil (Fabricius), Kaneohe Bay, 2 fathoms, and Kewalo Bay, Oahu, Hawaiian Islands, pelagic.

Cancer borealis Stimpson, off Fowey Rocks, Florida, 100 to 200 fathoms; *Poecilasma inaequilaterale* Pilsbry attached.

Cancer coronatus Molina, Ascension Island, Chile.

Cancer edwardsii Bell, Bahia Ancud, Chiloe Island, Chiloe Archipelago, 8 fathoms, and Port Lagunas, Chile, 9 fathoms.

Geryon quinquedens S. I. Smith, off Fowey Rocks, Florida, 100 to 200 fathoms; *Poecilasma inaequilaterale* Pilsbry attached.

Grapsus grapsus Linné, Jebwar, Jaluit Island, Marshall Islands, shore.

Geograpsus lividus (H. Milne Edwards), Jebwar, Jaluit Island, Marshall Islands, shore.

Sesarma (*Sesarma*) *rotundatum* Hess, Kusai, Caroline Islands.

Cardisoma hirtipes Dana, Kusai Island, Caroline Islands.

Uca annulipes (Latreille), Kusai Island, Caroline Islands.

Scyllarides aequinoctalis (Lund), Funchal, Madeira Islands, and Galapagos Islands.

Nephrops norvegicus (Linné), Almeria, Spain, Mediterranean.

Peneus merguiensis de Man, 7 miles N. E. of Corregidor Island, Manila Bay, Philippine Islands, 25 fathoms.

Palaemon caementarius Molina, ss. Poeppig, Callao, Peru.

Petrochirus bahamensis (Herbst) in shell of *Cymatium gibbosum* Broderip, 5 miles off Perlas Islands, Panama Bay, 45 fathoms.

Calcinus elegans (H. Milne Edwards), Kusai, Caroline Islands.

Pagarus cataphractus Boone (new species), Lahaina, Maui, Hawaiian Islands.

Pagurus deformis H. Milne Edwards, in shell of *Turbo* species, Zamboanga, Mindanao, Philippine Islands.

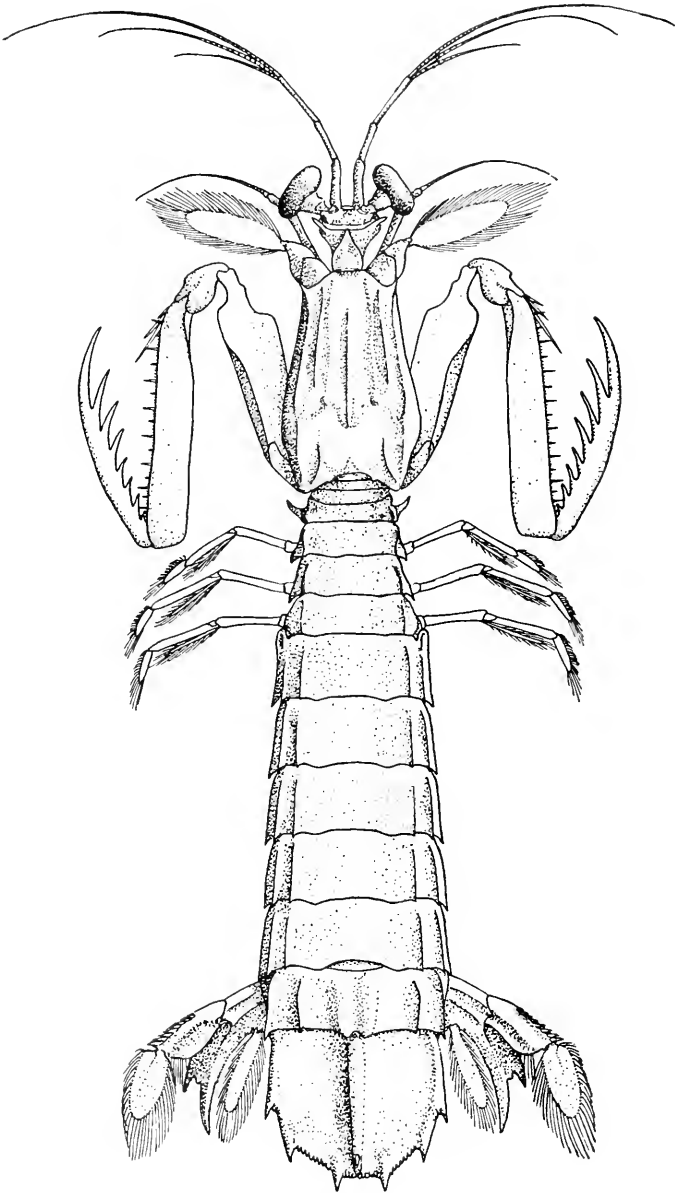
Pagurus varipes Heller, in shell of *Dolium* species, Lahaina, Maui, Hawaiian Islands.

Munida gragaria (Fabricius), Chile: Lengua de Vaca, Point Light, Ton Gay Peninsula, 90 fathoms, Port Lagunas, 9 fathoms, and Chiquiso Channel, between Chiloe and Cailin Islands, Chiloe Archipelago, 7 fathoms.

Petrolisthes granulosa (Guerin de Meneville), Clotilde Island, Chiloe Archipelago, Chile, on shore.

Lepas anserifera Linné, on *Sepia smithi* Hoyle, Indian Ocean.

Verruca alba Pilsbry on *Cidaris abyssicola* (A. Agassiz), off Sand Key, Florida, in 65 and 100 fathoms.



Squilla gilesi Woodmason, Mss., Kemp, $\times 0.9$, from Singapore.

Order: STOMATOPODA

Family: SQUILLIDAE

Genus: LYSIOSQUILLA Dana

Lysiosquilla maculata (Fabricius)

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Vol. II, pl. 3, vol. V, pl. 6

MATERIAL EXAMINED: One very fine specimen, measuring 22.4 centimeters long, was taken in 2 fathoms, low tide, Kaneohe Bay, Oahu, Hawaiian Islands, by the "Ara," December 18, 1928.

DISCUSSION: For full discussion of this species, consult Lee Boone, Bulletins of the Vanderbilt Marine Museum, Vol. II, p. 29, pl. 3, 1930, and Vol. V, p. 21, pls. 5 and 6, which present respectively discussions of the species from the Florida Keys and from Papeete, Tahiti, Society Islands material.

This Hawaiian specimen conforms in all essentials with the earlier described examples of the species. The Oahu specimen is somewhat longer and has the telson margin much eroded. The characteristic black colour bands are very distinct. There are no small denticles present on the posterior margins of the posterior two pretelsonic somites. There are nine teeth present on each retrochela.

Length: 22.4 centimeters measured from the apex of rostrum to posterior margin of telson.

Genus: SQUILLA Fabricius

Squilla gilesi Woodmason Mss., Kemp

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Plate 71

TYPE: This species was founded on a male, 94 millimeters long, and four females, 82 to 72 millimeters long, taken off the Madras coast, in 80-120 fathoms (Lat. 18° 18' 15" N., Long. 80° 18' 30" E.), by the "Investigator" and deposited in the Calcutta Museum.

DISTRIBUTION: In addition to the type locality, seven other specimens were taken by the "Investigator" at three more stations,

i. e., off the Orissa coast; northeast Bay of Bengal, 65 fathoms, and in the Persian Gulf, 35 fathoms. All of the above specimens are deposited in the Calcutta Museum, which makes the two large specimens procured by the "Alva" of unusual value to science, since they appear to be the first record of the species in an American Museum, as well as to establish another record for it.

MATERIAL EXAMINED: Two very fine specimens, 145 millimeters long and 142 millimeters long, from Singapore, Malay Straits, collected by the "Alva."

COLOUR: Unrecorded. In the present spirit specimens there remain a pair of large, suboval, blackish-gray pigment spots, one adjacent on either side, near the base of the median carina of the telson; on the distal, inner and outer branches of the uropoda there are also fine specklings of blackish-gray pigment spots, forming a dark shading on the inner half of each blade.

TECHNICAL DESCRIPTION: This species is very closely allied to *Squilla lata* Brooks, which was founded on specimens taken by the "Challenger" in the Arafura Sea, south of New Guinea, in 49 fathoms, and deposited in the British Museum of Natural History, the largest specimen recorded being 82 millimeters long. Mr. Kemp (1913) recorded the second finding of *S. lata* by the "Investigator," based on three specimens taken in the Gulf of Martaban, Burma, 53 fathoms, deposited in the Calcutta Museum, and described differences existing between the Bay of Bengal specimens and those from the Arafura Sea, suggesting that if these differences proved to be constant, it may be necessary to establish a subspecific rank for the Gulf of Martaban specimens. The fact that Mr. Kemp had specimens of *S. lata* as well as the above cited series of *S. gilesi* is of interest, eliminating any doubt of their confusion.

The "Alva" specimens measure, respectively, 145 millimeters long from apex of rostrum to posterior margin of telson and 142 millimeters, each being more than one and a half times as long as the largest known specimen previously taken.

The rostrum is 1.5 times as long as its proximal width and the lateral margins are very sinuate, more so that in *S. lata*, the proximal half being convex, thence concave, tapering to a narrowed, subacuminate apex. It is not carinate dorsally. The basal antennal article, seen dorsally on either side of the rostrum, bears anterolaterally an acuminate, triangulate process, directed obliquely out-

ward. The eyes are large, blackish, reniform, set obliquely on strong stalks, the proximal ophthalmic article bears dorsolaterally on either side distally, a small, rounded, wing-like process. The carapace is two-thirds as wide proximally as long medially, but attains a greater width between the acuminate wing-like produced angles of the lateral margins, which occur about one-third of the carapace length from the posterior margin, while the anterior width of the carapace is only slightly more than one-half of the length. The anterior margin is truncate at the base of rostrum and on either side concave, the anterolateral angle being an acute spine. The lateral margins are sinuate, divergent posteriorly, produced to form the downward directed, lateral processes, situated two-thirds of the length from the front; posteriorly the lateral margins converge with the posterior margin, the postlateral angles being rounded. This posterior margin is concave medially. The median carina has the anterior third so faint as to be scarcely a carina, the posterior two-thirds becoming a definite carina, which becomes obsolete posteriorly near the cervical groove. In line with this median carina, there is a small, flat, triangular tubercle on the posterior margin of the carapace. There are two longitudinal sulci, one on either side of the median carina and between each lateral sulcus and the lateral margin, two, well separated, longitudinal carinae, the upper of which begins a short distance behind the anterior margin of carapace, is discontinued about 2.5 millimeters anterior to the cervical sulcus, then resumes; posterior to this sulcus, the carina is continuous with that bordering the outer postlateral angle and lower lateral margin of carapace. The lower lateral carina originates as an acute lateral spine at the anterolateral angle of carapace and is unbroken in its slightly sinuate course, terminating near the posterior margin. The cervical groove is sharply defined. Just anterior to it, and adjacent to the longitudinal sulci on the lower side, there is a pair of node-like elevations.

The third thoracic segment is short, with the anterolateral process produced to an acute tooth or spine anteriorly and rounded unequally posteriorly; above this lateral process, the posterior portion of this segment is separately produced into an elevated, subacuminate process, margined by a carina, which curves upward along the hind margin and is continuous with the curved longitudinal upper lateral carina of this segment.

The fourth somite is nearly twice as long as the third, and has the extreme postlateral angle produced into an elongate, acuminate, triangulate process, bent outward; anteriorly this lateral margin is sinuate, forming a rounded process slightly in advance of the median area.

The fifth somite is subequal in length to the fourth, the carinate lateral margin is sinuate, with a reduced lobe medially and the postlateral angle forming a slightly larger, acuminate, triangulate tooth.

The sixth thoracic somite bears the typical *Squilla*, rounded, anterolateral process which overlaps the bases of the last pair of legs and which process is dorsally carinate.

Except for this flaplike process on the first somite, the first five abdominal somites are similar, nearly subequal, in length, with the lateral margins carinate and produced at the postlateral angle into an acute, small spine, which is about 1.5 millimeters long. The sixth abdominal somite is a trifle shorter than the fifth, with the lateral margin oblique, above the base of the uropoda and bearing in addition to those carinae common to all the abdominal somites, a submedian pair of thicker, longitudinal ridges, which arise shortly behind the anterior margin of the somite and each terminates posteriorly in an acuminate tooth, which projects, one on either side of the median carina of the telson. In addition to the carinate lateral margins, there are two pairs of lateral carinae, the upper of which occur about halfway between the median dorsal line and lateral margin, originating on the hinder portion of the third thoracic somite and being similarly present on the postlateral three-fourths of each of the remaining thoracic somites, terminating bluntly on their respective posterior margins, while on the abdominal somites this carina begins in each instance slightly behind the anterior margin and terminates in a small spine projecting beyond the posterior margin of the first four abdominal somites, while on the fifth somite, this spine occurs slightly in advance of the posterior margin and on the sixth somite, the carina is sinuated anteriorly and interrupted briefly, while posteriorly the terminal spine occurs in advance of the hinder margin. The second lateral carina is located midway between the upper carina and lower lateral margin and originates on the rounded antero-lateral process of the first thoracic somite, just behind the ante-

rior margin and terminates posteriorly on each somite in a small acute spine, which projects beyond the somite margin. These spines on the posterior three somites become successively stronger.

The telson is shield-shaped, with a strong median keel, which extends from the anterior margin to the posterior, bearing a subterminal, blunt tooth, also a small, distal marginal tooth. The posterior margin bears three pairs of large teeth, a submedian pair, separated from each other by a series of small teeth, and on the outer side, a series of small teeth; next the paired, distal, lateral, larger teeth, which on the outer side, form a thick, carinate margin, separated at the base by one to three small denticles adjacent to the large terminal tooth of the proximal lateral margin, which likewise forms a strong marginal carina extending to the base of the telson. The uropod peduncle has a small acute spine distally above the base of the outer blade, also three longitudinal carinae, two marginal, and a median one, which is continued down the long inner process, to the apical spine, which extends as far as the distal lateral spine of the telson; there is also a similar, strong, ventral carina on this process. The inner lateral margin of this process, which differs from that of *Squilla lata*, is coarsely crenulate, not denticulate, almost to the apex of the spine. Proximally on the inner side of this spine, the intermediate, distal margin forms a small rounded node and thence recedes to the base of the outer distal spine of the process which is only about half so long as the inner spine and is heavily carinate on the ventral side, this outer spine extending about as far as does the narrowly oval distal inner blade. The outer blade has the proximal portion with a strong median dorsal carina and with the outer lateral margin carinate proximally and set with nine, articulate, strong spines on the distal portion; the distal blade is unequally ovate. Both distal blades are fringed with long, web-like setae.

The retrochela has the propodus armed with about six, spaced, primary spines, along the inferior lateral margin, with about one, occasionally two, half-so-long, secondary spines spaced between the primaries, also several smaller, acuminate spines, so spaced. There are also a long and a short obliquely set spines inset on the proximal end of the propodal margin. The dactyl has its inner margin developed into eight strong, curved teeth,

which successively increase in length from proximal to distal and which interfit into the apertures of the opposed face of the dactyl.

As stated by Mr. Kemp, the secondary sexual characters are strongly marked in this species. The adult males have the distal end of the retrochela-propodus much wider than that of the female; the proximal end of the related dactylus is also dilated with the teeth shorter and the outer margin much more convex. The adult males have the median carina of the telson much more inflated and also the greater part of the distal margin is swollen.

REFERENCES: *Squilla gilesi*, LLOYD, R. E., Records Indian Mus. Calcutta, 1908, vol. II, p. 33 (without description, cited by name only.—KEMP, S., Mem. Indian Mus., 1913, vol. IV, p. 39, pl. 2, figs. 25-27.

Subtribe: **Gymnopleura**

Order: **DECAPODA**

Suborder: **Reptantia**

Tribe: **Brachyura**

Family: **RANINIDAE**

Genus: **RANINOIDES** H. Milne Edwards

Raninoides loevis Latreille

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Volume II, plate 9

DISCUSSION: Through an unfortunate oversight which was immediately corrected in the Errata (1930), *Raninoides loevis* Latreille was cited in Volume II, Bulletin of the Vanderbilt Marine Museum, p. 48, as *R. loevis lamarcki*. The Perlas Islands material above described, together with material from the Marquesas Keys, Florida, has recently been separated from the latter, *without examination of the series of specimens*, by Miss M. J. Rathbun, who designates it as *R. benedicti*. The exceedingly trivial characters which she ascribes as definitive of *benedicti* would be of questionable value for specific rank, if they were based on anatomic evidence and of constant status, which they are not. These so-called "characters" are highly variable, within all series

of specimens available, including those of the United States government collection, this variation occurring with equal frequency among specimens from both east and west tropical America, and being correlated with: (a) size of specimen; (b) age and erosion of existent carapace, which, owing to the burrowing habits of the species, is subject to more than usual polishing by sand, etc., and (c) to secondary sex characters, particularly with reference to the chelipeds of large, old males, as compared with those of young males and females. Several of the specimens examined by the present writer showed the "inner angle of the frontal tooth" less developed on the right side, corresponding to character assigned to *benedicti*, but on the left side, more developed, hence *loevis*. The anterolateral spines of recently moulted specimens were invariably acuminate, also those of large old males were frequently more acuminate than of smaller males and females, irrespective of their geographic occurrence. Likewise the chelipeds of large males have, in common with hundreds of other species of crabs, more development apparent in the propodi and dactyli than do young males and females. Specimens from Cuba and Haiti, examined by the present writer, have in some instances, chelae even larger than those from the Perlas Islands shown in plate 12. Some specimens from the Texas Gulf of Mexico coast, examined by the writer, also have this character, and in two instances, show a pearly granulation of the anterior of carapace, which has been made much of as diagnostic of the questionably valid *R. ecuadorensis* Rathbun. Most of the West Indian specimens with fairly recently moulted carapaces have a distinct rostral carinal line. The dactyl of the third ambulatory leg, measured critically, has no variation, except development due to growth, through the entire series of specimens, from both east and west coasts of the Americas, hence no specific value.

REFERENCES: *Raninoides loevis lamarchi*, BOONE, L., Bull. Vanderbilt Mar. Mus., 1930, vol. II, p. 48, pl. 12; Errata, p. A, as *R. loevis* Latreille.

Raninoides benedicti, RATHBUN, M. J., Bull. CLXVI, U. S. Nat. Mus., 1937.

Subtribe: Oxystomata**Family: CALAPPIDAE****Genus: CALAPPA** Fabricius***Calappa philargius* (Linné)**

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Plates 72 and 73

TYPE: Linné's type was from Asia and was originally deposited in the museum Ludovicæ Ulricæ, No. 462.

DISTRIBUTION: Described in 1758 by Linné as "from Asia," there are today less than twenty reliable records for this species. These establish its distribution from the Red Sea eastward through the Indian Ocean archipelagoes and northward to Japan and eastward in the tropical central Pacific to Samoa. These records include: Asia and seas of Asia (Linné, Herbst, Fabricius, Bosc, Latreille, H. Milne Edwards and others); Amboina (de Man); north Celebes (Thallwitz); Java (Herklots); Japan (de Haan); Ternate and Lagundi Bay (Nobili); Ruck Island and Hondo (Parisi); "Siboga" station 313, Dangar Besar, 33 meters (Ihle) Mergui, the Andamans, Ceylon and the Persian Gulf (Alcock, Calcutta coll.). The "Ara" records add a new locality for this species, Singapore.

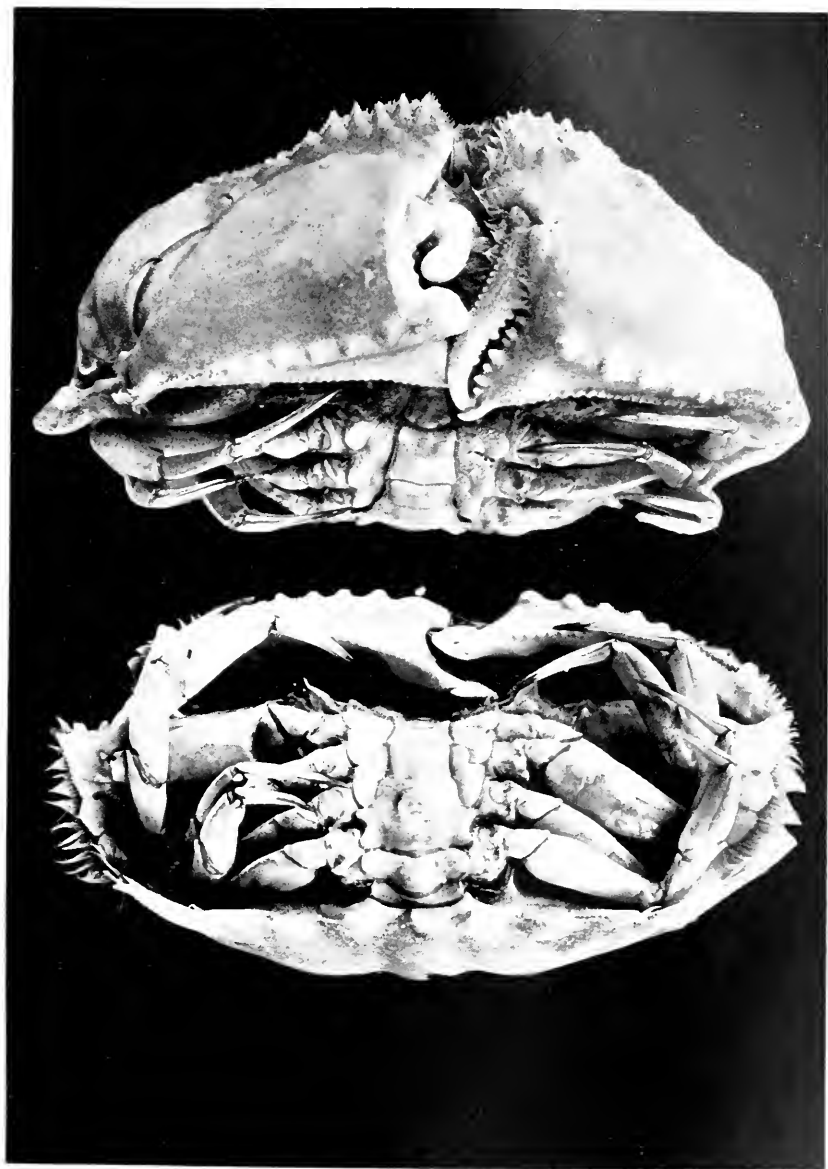
MATERIAL EXAMINED: One male, collected at Singapore, Malay Straits, February, 1929, by the "Ara" World Cruise.

COLOUR: Unrecorded.

TECHNICAL DESCRIPTION: The carapace is decidedly convex dorsad, with the anterior margin widely convex, beaded, the clypeiform expansions prominent, nearly as wide transversely as long on the oblique antero-posterior border, with the margins cut into about six large, laciniate teeth, the median or apical pair being unequal, marginally beaded and conspicuously longer than either the posterior two, or anterior two. The posterior margin has a strong, triangular, median tooth or spine, and a pair of submedian, subequal teeth, one on either side, defining the limits of the posterior margin. The dorsal surface is marked by the deep, paired, longitudinal, cardio-gastric sulci; otherwise, the surface is comparatively smooth except for a series of twenty to thirty low, rounded granules anteriorly, mostly in the postorbital and mesogastric areas, and on either side of this, in the hepatic-mesobranchial areas, are about six, shallow, unequal, oblique



Calappa phillargius Linné, $\times 1$, male specimen from Singapore



Calappa philargius Linné, male, slightly reduced, from Singapore.
Anterior view showing chelipeds, and ventral view, showing
marginal outline, also male belt.

grooves, which with the rounded ridges between combine to give the surface a rippled appearance, very like the water-marks in the sand.

The chelipeds are subequal in the male with only the distal portion of the merus visible dorsally, this being expanded sub-distally into a quadridentate, marginal lamina that continues the line of the posterior dentate margin of the clypeiform process and in turn is continued anteriorly by the dentate-crenulate lower margin of the propodus; the true distal meral margin is smooth, interfits at the inner distal angle into a notch on the carpal margin and is subdentate at the outer angle; the upper surface of the carpus is smooth except for two grooves which originate near the outer proximal angle, the shorter one curving transversely across the proximal region and the longer one running above and subparallel to the distal, outer, carpal margin. The palm is high, produced on the upper margin into a dentate crest, cut into about seven teeth, which increase in height from proximal to distal, the distal four being quite acuminate; there are also about six to eight low nodules below the distal portion of the crest and along the distal margin above the base of the hinged finger. The fingers are deflected and inbent. The lower margin of the palm is regularly beaded and there is above this a ridge-like series composed of a proximal tooth and six large, rounded nodules, well spaced, which increase in size distad, the distal node being approximately midway the base of the lower finger. The latter is a broad, short triangle, with seven or eight teeth along the cutting edge and a stronger, longer, curved apical tooth. The hinged finger is longer, slenderer, curved, swung obliquely. The inequality between the right and left chelae characteristic of *Calappa* exists in this species, as shown in plate 73.

The ambulatory legs are slender, decreasing in size from the first to fourth pairs.

REFERENCES: *Cancer philargius*, LINNE, C. VON, Syst. Nat. 1767, Ed. XII, p. 1042.
Calappa philargius, DE HAAN, Fauna Japonica, 1850, p. 71, pl. 19, fig. 1, pl. E.—PARISI, B., Atti Soc. Ital. Sc. Nat. 1914, t. LIII, p. 284 (with extensive references).—IHLE, J. E. W., Siboga Expeditie, Decap. Brachyura, III, Oxystomata, Monogr. XXXIX-b-2, 1918, Leiden, p. 183 (with additional references).

Calappa hepatica (Linné)

Volume V, plates 8, 9 and 10

MATERIAL EXAMINED: Two young males taken in one fathom, low tide, Kaneohe Bay, Oahu, Hawaii, December 15, 1928, by the "Ara."

REMARKS: These specimens measure 8.5 and 9 centimeters maximum width, respectively. Each has the anterior two-thirds of the carapace and external surface of the chelipeds abundantly tuberculose, as is characteristic of this species. It was also taken by the "Alva" World Cruise, 1931-32, on coral reefs, in Anaho Bay, Nuka Hiva Island, Marquesas Islands, and is fully described and figured in Volume V, Bulletin of the Vanderbilt Marine Museum, 1934, p. 32, plates 8, 9 and 10.

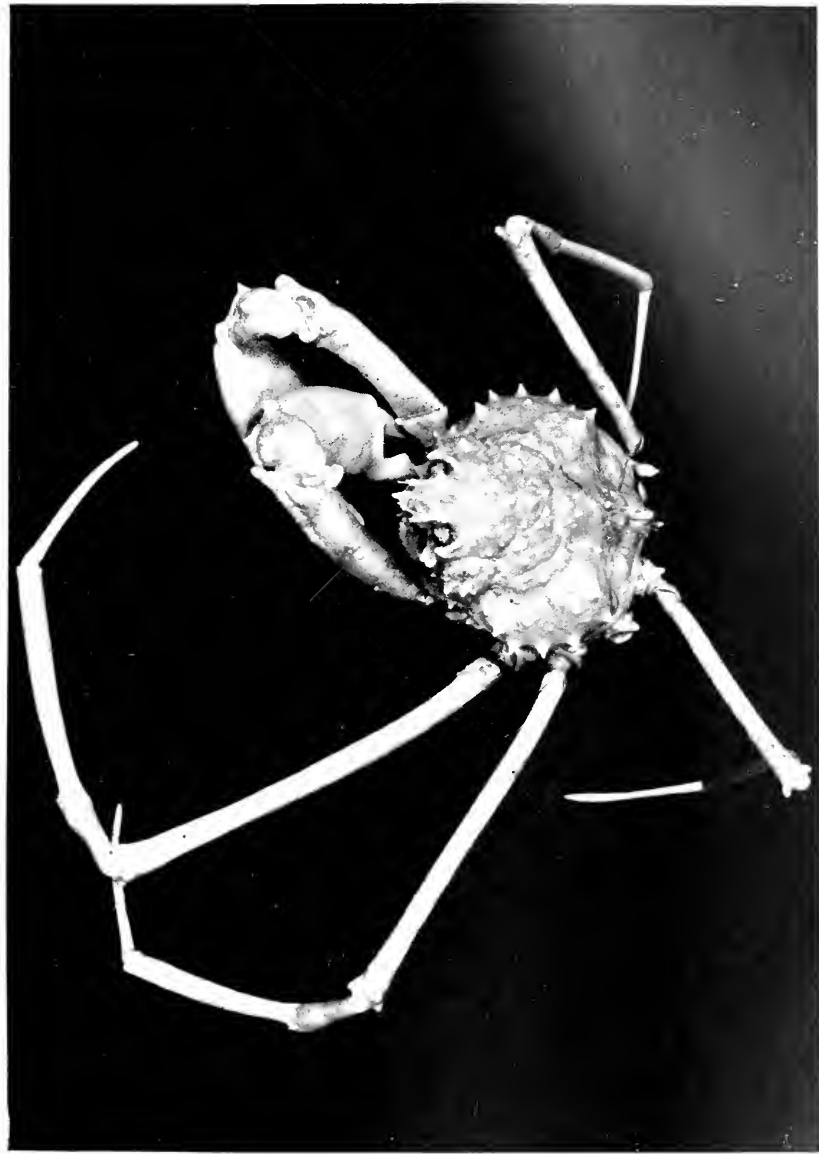
REFERENCES: Above citation, BOONE, L.—IHLE, J. E. W., Siboga Expeditie, *op. cit.*, p. 183.—EDMONDSON, C. H., Bull. XXVII, B. P. Bishop Mus., 1925, p. 30.

Subtribe: **Brachygnatha**Superfamily: **Oxyrhyncha**Family: **MAJIDAE**Subfamily: **Inachinae**Genus: *Anasimus fugax* A. Milne Edwards

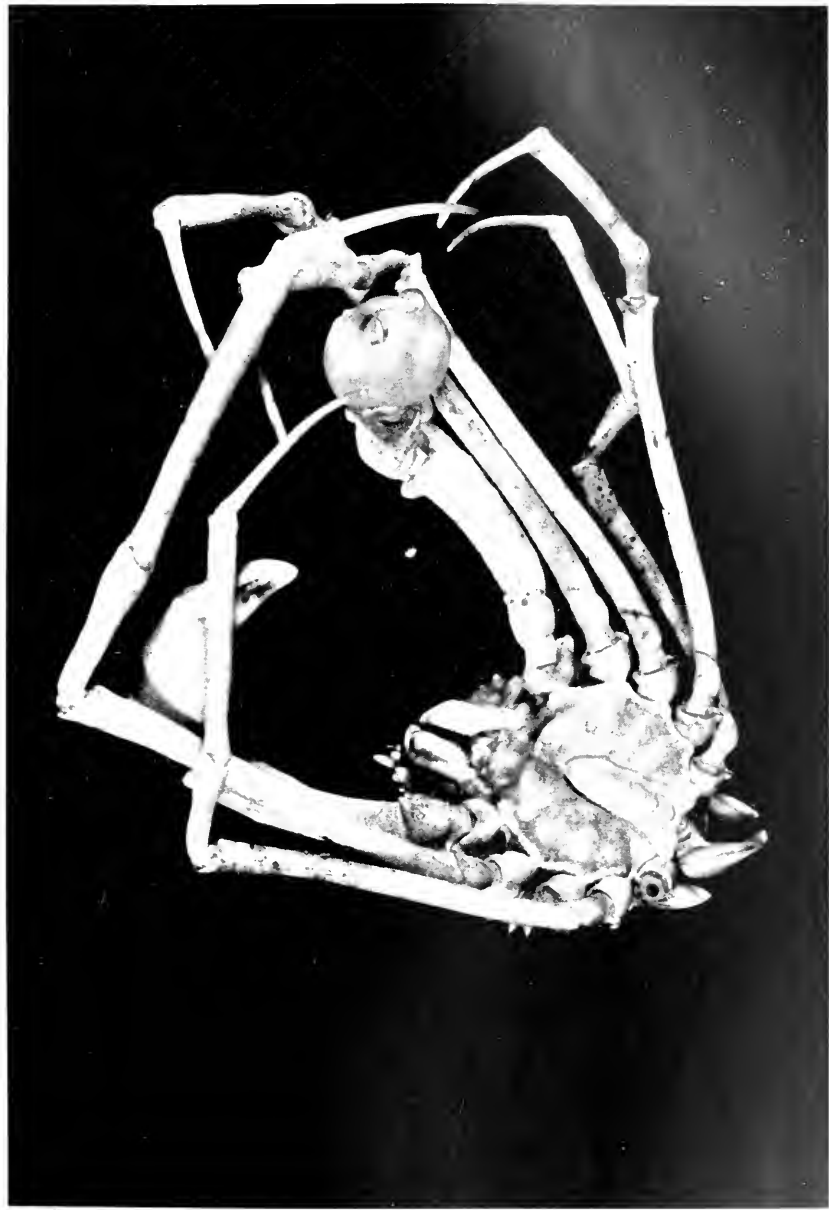
Plates 74, 75, and 76

TYPE: This species, first collected by the United States government steamer "Blake," was based on three specimens, a female and two males, taken in three deep-water localities, near Santa Cruz, depth 115 fathoms, deposited in the Paris Museum, and from two "Blake" stations, off Barbados, in 56 and 81 fathoms, deposited in the Museum of Comparative Zoology, Cambridge, Massachusetts.

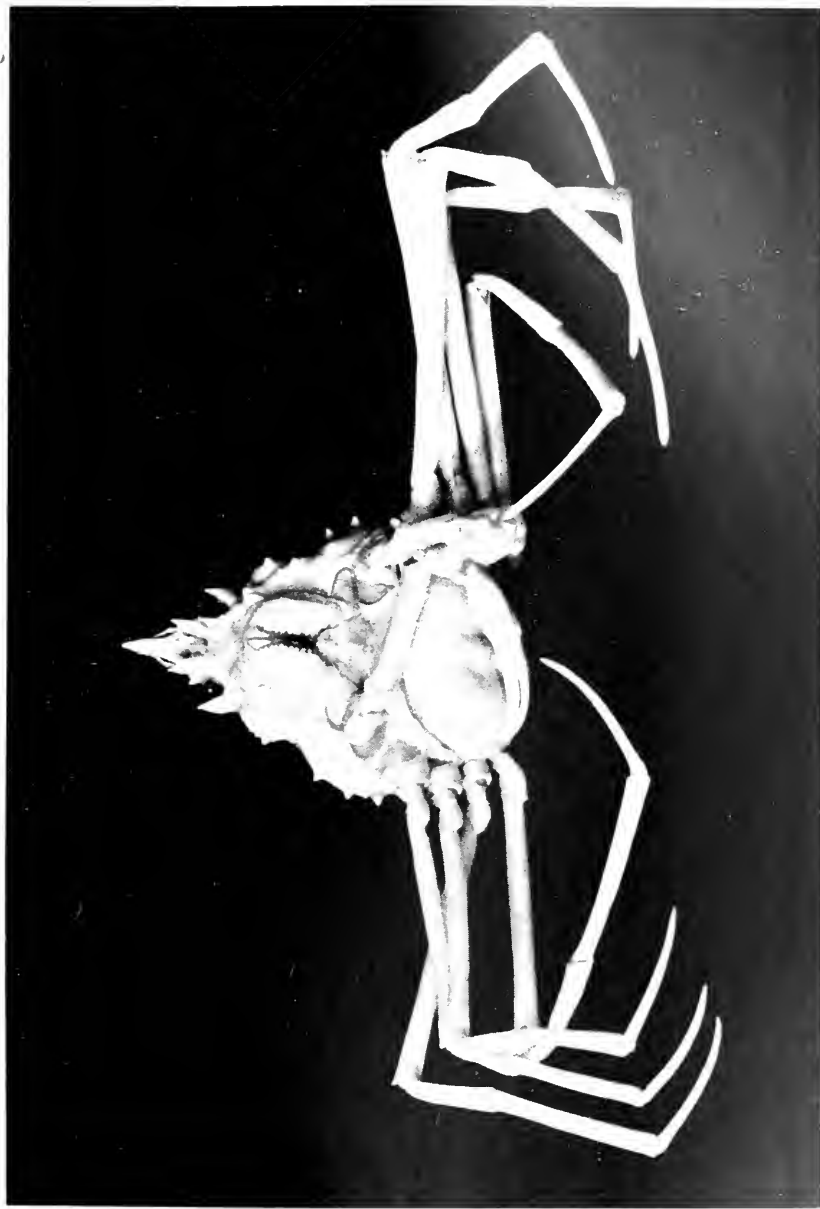
DISTRIBUTION: This species is strictly confined to deep water, having a known range from 35 to 80, 97 and 120 fathoms from off southern Florida to Cape Frio, Brazil. It has been dredged from



Anasimus fagax A. Milne Edwards, dorsal view of male, \times about 1, from off Sombrero Light, Florida, in 80 fathoms.



Anasimus jaguar A. Milne Edwards, ventral view of male, \times about 1, from off Sombrero Light, Florida, 80 fathoms.



Anasimus fagae A. Milne Edwards, ventral view of female, \times about 1.3, from off Sombrero Light,
Florida, 80 fathoms.

off Santa Cruz and off Barbados, by the "Blake," at "Fish Hawk" station 6076, Mayaguez Harbor, Porto Rico, and off Cape Frio, Brazil, depth 35 fathoms, by the U. S. steamer "Hassler." The "Alva" station, 13 miles off Sombrero Light, Florida, depth 80 fathoms, establishes the most northern record for this species.

MATERIAL EXAMINED: Eight specimens, seven males and a female, dredged at Sombrero Light, Florida, bearing 54° true, distant 13 miles, in 80 fathoms, January 23, 1933, by the "Alva."

TECHNICAL DESCRIPTION: The single haul made by the "Alva" off Sombrero Light, Florida, fortunately resulted in a catch, consisting of more and larger specimens than are known from the total number taken by all previous expeditions. The present series of specimens (preserved) are a rich old ivory.

These specimens give the following measurements, all expressed in millimeters:

<i>Length of carapace</i>	<i>Width of carapace</i>	<i>Sex</i>
33	28	Male
44.5	33.5	Male
34	28.2	Male
42	35	Male
41	33	Male
39	32	Male
33.5	26	Female

The carapace is pyriform, the rostrum being a single sharp spine compressed laterally, the dorsal margin laminate, deflected distally and acuminate. There is a median postrostral depression between the orbits. The supraorbital spine is distinct; the postorbital angle forms a much stronger, triangulate tooth. All of the regions of the carapace are sharply defined, the cervical, urogastric and cardiac depressions being especially deep. The lobes are all quite convex and ornamented with numerous spines, which in this species, as in the majority of bathypelagic brachyura, show considerable individual variation. In the median line there are two large gastric spines, with a variously obsolete or weak third spine between these, the posterior gastric spine normally being much the strongest of the gastric series; on the apex of the cardiac region there is a second strong tooth, posterior to this a weaker spine, followed by another spine on the intestinal

region, almost on the posterior margin. In line with these, there is also a strong, posteriorly directed, median spine on the posterior margin of the first abdominal somite of both males and females. There are three primary spines on the branchial region in series, the anterior one being sometimes equally strong, sometimes very much weaker than the posterior two of this series. There are also several small spinules on the protogastric, hepatic, epibranchial and mesobranchial regions, these forming a near-marginal series on the hepatic and branchial regions. While the distribution of these spines is similar on all eight specimens, their number and degree of development is quite variable, the spines attaining greatest development on the large old males, while on the one female the lesser spines are reduced in some degree, some being entirely absent.

The male belt is of the usual narrowed triangulate shape, the proximal article is dorsolateral with a strong, deflected, median spine, directed posteriorly; the second somite is short, lateral, with a small median tubercle; the third somite is hinge-like with the lateral angles produced in strong, triangulate processes, each abutting the coxal joint of the fifth pair of legs; the fourth article is ventrad, about as long as the third but narrower with the posterior median area elevated; the fifth somite is 1.5 times as long as the fourth with the postmedian area tumid; the sixth and seventh somites are fused; lateral nodes on either margin indicate the suture; the sixth somite is 1.3 times as long as the fifth somite, the fused seventh somite is 0.8 as long as the sixth; the sixth somite has a prominent median dilation; the seventh somite is triangulate, rounded distally.

The female belt has the first article dorsolateral, bearing a strong spine, directed posteriorly, as in the male, but the second, third and fourth articles are short, wide, hinge-like, with the median area set apart from the lateral by paired longitudinal constrictions; the fifth, sixth and seventh somites are completely coalesced, forming a wide, subcircular, externally convex, internally concave pouch, which extends to the basal articles of the legs.

The male chelipeds are much longer in ratio to the related body than are those of the female. The merus and carpus are of similar contour and similarly spinose in the two sexes, but the male propodus has the palm greatly dilated, the outer face being

very convex, from 1.3 to 1.5 times as long as the fingers, which are slender, tapered, acuminate, incurved distally with a deep buttonhole-like gape, wider proximally; there is a large molar located about one-third of the length from the base, the distal two-thirds of the cutting edges meeting, regularly serrate, with weak teeth.

The basal antennal joint bears a strong tooth at the external distal angle.

The female chelipeds are weak, slender, the merus being only 12.5 millimeters long, granulose, with the upper and lower lateral margins irregularly spinose, an acute tooth at the upper distal angle and a large rounded node at the lower one; the carpus is short, 4.5 millimeters long, convex, suboval, irregularly spinose; the propodus and dactyl elongate, 18 millimeters long, the palm being 8 and the dactyl 10 millimeters, with the palm but little inflated, granulose, the fingers subequal, meeting the greater part of their length, a weak, longitudinal, rounded ridge on the outer surfaces, 18 to 20 small, triangular teeth, tips acuminate, incurved.

The ambulatories of both sexes are exceedingly long, slender, decreasing moderately in length from the first to fourth pairs; the meral articles are greatly elongated, with an upper distal spine; the carpus and propodus together about equal the merus in length, the carpus being two-fifths of this; the dactyl being slightly more than three-fourths as long as the propodus, slender, with the distal half very curved and dorso-ventrally expanded, apex very acuminate.

REFERENCES: *Anasimus fugax*, MILNE EDWARDS, A., Crust. Règne Mexico, 1880, p. 350, pl. 31-A, figs. 1-1d; Bull. Mus. Comp. Zool., 1880, vol. VIII, p. 9.—RATHBUN, M. J., Bull. U. S. Fish. Comm. for 1900 (issued 1901), vol. XX, pt. 2, p. 59.—MILNE EDWARDS, A., et BOUVIER, E. L., Mem. Mus. Comp. Zool. 1923, vol. XLVII, p. 366, text fig. 16.—RATHBUN, M. J., Bull. CXXIX, U. S. Nat. Mus., 1925, p. 64, pl. 23, figs. 5 and 6, pl. 211.

REMARKS: Critical examination of the type and related specimens described by Miss Mary J. Rathbun as *Anasimus latus* show these not only to be devoid of any valid specific characters,

but to possess such individual variation grading into typical *A. fugax* as to render the *A. latus* specimens unstable as a variety. The so-called *latus* specimens, the greater portion of which are young specimens, mostly small females, were collected off South Carolina, off the Florida Keys, in the northeastern portion of the Gulf of Mexico, and one station west of Trinidad, in depths ranging from 26 to 88 fathoms. These are deposited in the U. S. National Museum.

The one male specimen reported by the writer (1930) from south of Marquesas Keys, Florida, in 70 fathoms, is a young male having considerable variation from typical *fugax*.

Anasimus latus, Rathbun, M. J., *loc. cit.*, p. 65, pl. 214 (with earlier references). Boone, L., Bull. Vanderbilt Mar. Mus., 1930, vol. II, p. 74, pl. 20.

Subfamily: Pisinae

Genus: ROCHINIA A. Milne Edwards

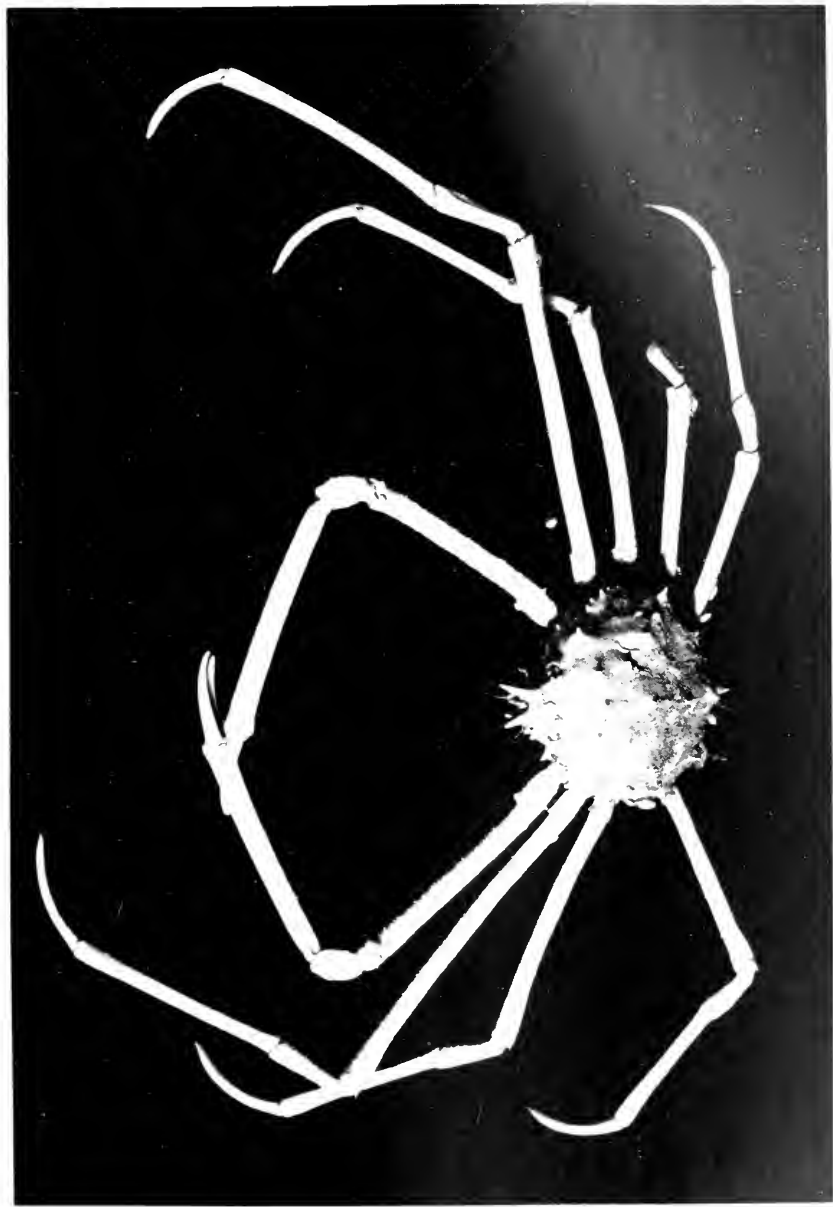
Rochinia crassa (A. Milne Edwards)

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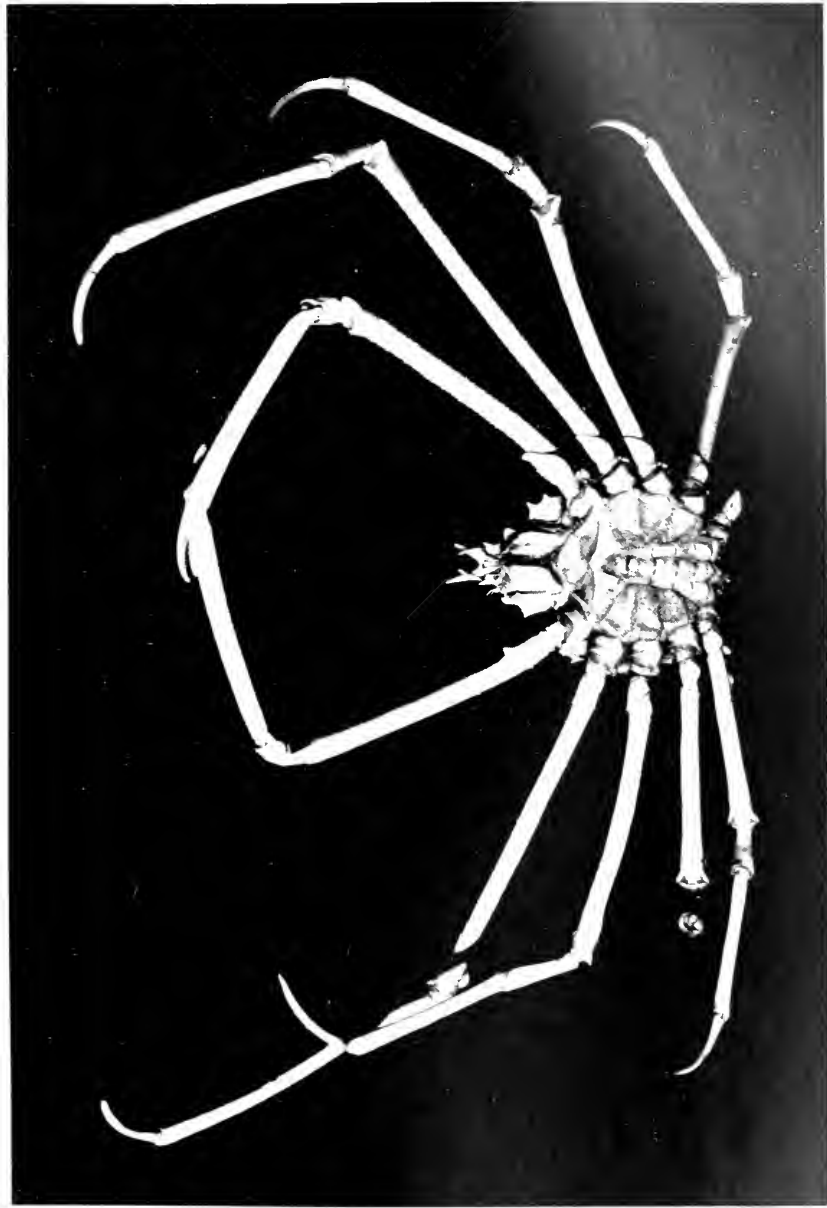
Plates 77 and 78

TYPE: This species was first dredged by the U. S. Steamer "Blake," in 229 fathoms, between Cuba and Florida, on the Pourtales Plateau, Lat. 24° 15' N., Long. 82° 13' W., a single male specimen, deposited in the Museum of Comparative Zoology, Cat. No. 2862, Cambridge, Massachusetts.

DISTRIBUTION: The known range of this interesting species is confined entirely to deep-water dredgings in the western Atlantic Ocean, off the coast of the United States, from Cape Cod, Massachusetts, southward to southern Florida, where it has been taken in depths ranging from 70 to 334 fathoms, by the United States government steamers "Blake," "Fish Hawk" and "Albatross," off Nantucket Shoals, south of Martha's Vineyard, off Cape Hatteras, off Cape Romain, off Charleston, off Savannah, off Fernandina, off St. Augustine, off Carysfort, in the Gulf Stream, off Cape Florida, and south of Marquesas Keys, and off American Shoal Light, off Sand Key Light and on the Pourtales Plateau, in 90 to 110 fathoms, by the Biological Expedition of the State University of Iowa of June, 1893. The "Alva" record



Rachinia crassa (A. Milne Edwards), dorsal view of male, greatly reduced, from off Fowey Rocks, Florida, in 100 to 200 fathoms.



Rochinia crassa (A. Milne Edwards), ventral view of male, greatly reduced, from off Foxey Rocks, Florida, in 100 to 200 fathoms.

of this species, represented by one of the largest specimens known and a smaller male from off Fowey Rocks, Florida, in 100 to 200 fathoms, adds another Florida station for it.

MATERIAL EXAMINED: Two males, taken in 100 to 200 fathoms, dredged from 4 to 2.5 miles off Fowey Rocks, Florida (bearing true 289° to 273° true), November 29, 1935.

TECHNICAL DESCRIPTION: The larger male specimen has the carapace 95 millimeters long, including the rostral horns, which represent 6 millimeters of this total, the maximum width of the carapace being 74 millimeters.

The carapace is pyriform, very convex in both directions, with a slight but definite median carina; surface pubescent; the rostrum is prominent, deeply bifurcate. The greatest width of the carapace is across the cardiobranchial regions, from which point the postlateral margins are widely rounded and sinuate, while the anterolateral margins are decidedly convergent to the short, acuminate postorbital spine. The superior orbital margin sometimes, but not always, bears a small spinule, which on the larger specimen is reduced to a mere granule on the left side and is obsolete on the right. The preorbital teeth are much stronger than the postorbital ones, forming conspicuous, out-jutting, eave-like, triangular processes above the eye and projecting forward and obliquely outward beyond the preorbital margin. The remaining interorbital region is deflected and produced forward, forming a pair of very acuminate rostral horns, separated by a wide U-shaped sinus, each horn being directed slightly obliquely outward and extending as far forward as does the antennal peduncle. The dorsad of the carapace is very tumid, pubescent, with the regions sharply defined. The cervical and hepatic grooves are very distinct as are also the deep urocardiac pits, while paired sinuate longitudinal ridges accentuate the cardio-intestinal grooves. There is a conspicuous median longitudinal series of six large, upward directed, sharp spines which are connected by a polished carina. The first of these spines occurs on the mesogastric area, the second spine on the metagastric area, the third, fourth and fifth spines on the cardiac region, and the sixth on the intestinal region. The first and second somites of the male abdominal belt are subdorsad and bear respectively the seventh and eighth spines of this series, which are each directed posteriorly. Transversely in line with the first

mesogastric spine and longitudinally in line with the preorbital spines, there are a pair of sharp spines, one on either side on the mesogastric region, followed posteriorly by a well-spaced pair of larger spines, one on each side of the metagastric region. Approximately in line with these, there are three smaller spines, one at the anterior of the cardiobranchial carina, the second and third spines spaced along the posterior of the cardiac margin and slightly outside of this, on the branchial region, is yet another spine, these last three together forming a triangle. There is a large, out-jutting, strong spine on the center of the hepatic region; below this, on the lower margin, there are three unequal spines in close series and in line with these anteriorly there is another laminate, sometimes bifid spine at the buccal angle. Six or seven spinules occur irregularly spaced in linear series above the lateral margin on the branchial region, while dorsad on the branchial region there are three large spines obliquely in line with the first gastric spine; the first and second of these spines are on the anterior mesobranchial and the third spine is on the outer convex portion of the mesobranchial area, in line with the maximum width of the carapace. The male belt is composed of seven somites, the above mentioned first and second somites of which are subdorsal, each armed with a median spine, while the median area of all seven somites is tumid and set apart on either side by a sulcus from the outer lateral portions.

The cornea of the eye is small, black, subhemispherical, set terminal on the short, thickish, calcareous stalk which dorsally projects above the cornea; the visual range is chiefly lateroventrad.

The large male has the chelipeds moderately unequal (possibly due to regeneration of the left one; in the smaller male the chelipeds are about equal. The ischial joint of the larger specimen is short, strong, distally oblique, with a strong nodule at the anterolateral angle; the merus is 144 millimeters long, slender, subcylindrical, thickening a little distally, with the entire surface covered with coarse prickles, some few of which, near the proximal and distal margins, are coarser; the outer and inner distal angles of the merus each form a conspicuous node; the carpus is short, 25 millimeters long, with the upper surface convex, accentuated by three irregularly spinose carinae and a few scattered prickles; the propodus and dactyl are 165 millimeters long, of

which 40 millimeters represents the dactyl; the palm is narrowed, compressed subcylindrical, spinulose similar to the merus, dilated slightly near the base of the fingers, which latter are slightly deflected and also have their apices curved inward. The fingers are nearly equal, slender, long, rounded, granulose, distally tapered to acuminate, incurved apices. The lower finger has a hiatus proximally and eleven, low, blunt, triangular teeth along the distal three-fourths of the margin; the upper finger has a large molar midway the proximal hiatus and well separated from the eleven teeth which interfit with those of the opposed finger.

The four pairs of ambulatories are similar, very long and slender with strong, slender, procurved, acuminate dactyli. These legs decrease in the order 1, 2, 3, 4; the fifth pair of legs being scarcely three-fifths as long as the first pair. In the larger specimen, the first pair of ambulatories is only a few millimeters shorter than the chelipeds, but in the second specimen, a male with the carapace about three-fifths as large as that of the first specimen, the ambulatories exceed the length of the chelipeds, which are subequal and only 185 millimeters long, the ambulatories being 210 millimeters long.

- REFERENCES: *Amathia crassa*, EDWARDS, A. MILNE, Crust. Règne Mexico, 1879, p. 203, pl. 28, figs. 2-2b; Bull. Mus. Comp. Zool., 1880, vol. VIII, p. 3.
- Amathia agassizii*, SMITH, S. I., Bull. Mus. Comp. Zool., 1882, vol. X, 1, pl. 2, figs. 2 and 3; Proc. U. S. Nat. Mus., 1883, vol. VI, p. 3; Rept. U. S. Comm. of Fish and Fisheries for 1882 (issued 1884), p. 346.
- Anamathia crassa*, SMITH, S. I., Proc. U. S. Nat. Mus. 1884 (issued 1885), vol. VII, p. 493.—RATHBUN, M. J., Proc. U. S. Nat. Mus., 1894, vol. XVII, p. 60, pl. 1, fig. 4; Bull. Labr. Nat. Hist. State Univ. Iowa, 1898, vol. IV, p. 254, pl. 14.—FAXON, W., Mem. Mus. Comp. Zool., 1895, vol. XVIII, p. 10.
- Anamathia agassizii*, SMITH, S. I., *loc. cit.*, p. 493, vol. VII, 1884 (1885); Rept. U. S. Comm. Fish and Fisheries, for 1885 (1886), p. 624, pl. 1, figs. 2, 3, 3-c.
- Scyramathia agassizi*, SARS, G. O., Norske Norrhavs Exped. Crust., 1885, vol. I, p. 274.
- Rochinia crassa*, RATHBUN, M. J., Bull. CXXIX, U. S. Nat. Mus., 1925, p. 210, pls. 68, 69 and 226.

Subfamily: Majinae

Genus: STENOCIONOPS (Leach Mss.) Desmarest

Stenocionops ovata (Bell)

↑

Plates 79 and 80

TYPE: The type of Prof. Bell's *Pericera ovata* was a young female, with a length of one inch and breadth of 6 lines (about 0.6 inches), and a second female, collected in the Galapagos Islands, on coral sands, at a depth of 6 fathoms, by Mr. Cuming, and originally deposited in the "Mus. Soc. Zool." (London). The type of Miss M. J. Rathbun's *Stenocionops macdonaldi*, an adult male, was collected in the Gulf of California, as was also her type of *Pericera triangulata*, a young female; both of the latter types are deposited in the United States National Museum, as is also sufficient material representing various growth stages to correlate the later described species as synonyms of Prof. Bell's *S. ovata*.

DISTRIBUTION: This species has a bathymetrical occurrence of from 6 to 145 fathoms and a geographical range from the Gulf of California to the Bay of Panama and Galapagos Islands. It is very closely related to the east American species, *Stenocionops spinosissima* (de Saussure),¹ which is known under too many synonyms, ranging from off Cape Hatteras, North Carolina, to southern Florida, Haiti, the West Indies, the Gulf of Mexico and southward to the entrance of the Bahia Rio de Janeiro, Brazil, in depths varying from 22 to 60 fathoms.

MATERIAL EXAMINED: One large male, dredged at the "Alva" station 13, Banco Hannibal, 40 fathoms, Isla Coiba, Point Hermosa, distant 11.5 miles, bearing 50° true, Panama, March 7, 1938.

COLOUR: Carapace varying from rose-pink to almost scarlet beneath a pilose coating of velvety brown setae; apices of some of the eroded tubercles showing lime-white; fingers of chelipeds chalky white with faint rose tints. Eyes black.

TECHNICAL DESCRIPTION: In the very young the carapace is a long oval, with the primary spines, also rostral spines, relatively more conspicuous than they are in the older adults, but forming the same pattern.

¹*Pericera spinosissima* de Saussure, H., Revue et Mag. Zool. de Geneve, 1857, ser. 2, t. IX, p. 501; Mem. Soc. Phys. Geneve, 1857, t. XIV, p. 426, pl. 1, fig. 2.



Stenocionops orata (Bell), male, $\times 0.35$, from off Perlas Islands, Bay of Panama, in 45 fathoms.



Stenocionops ovata (Bell), male, $\times 0.35$, from off Perlas Islands, Bay of Panama, in 45 fathoms.

The present male measures: carapace, 15 centimeters long; rostral horns included, 14.8 centimeters maximum width; cheliped, 33.5 centimeters long. The carapace is broadly pyriform, moderately convex and uneven, slightly longer than wide, the maximum width occurring across the mesobranchial area, with the frontal margin produced into paired, submedian, rostral horns, which are about one-fifth of the total length, and slightly deflected, each horn being a rather broad, triangulate tooth, well separated from its companion. There is a distinct depression on the frontal region, posterior to the rostrum. The superior orbital tooth is strong, roof-like, triangulate; the postorbital tooth, slightly smaller, is also strong. The inferior preorbital tooth is acuminate, visible dorsally. The dorsad of carapace has the regions strongly delimited, with the areolae sharply defined, the gastric and branchial areas quite tumid; the dorsal surface is sculptured by a strong, median, longitudinal ridge which bears ten strong, conical, well separated spines or tubercles, these being located, four on the gastric area, one, cardiac, three, intestinal and one, posterior margin. Posterior to the rostrum there is a heart-shape, or oval depression, outlined by about three denticles on either side, the posterior pair of these being the largest. There is also on the gastric region a submedian pair of tubercles, one on either side, in line with the first median gastric tubercle, and also with the hepatic dorsal tubercle. The hepatic lobe is sharply defined, produced marginally into a broad, triangulate, bifid tooth, the anterior lobe of which bears a smaller tooth proximally, on the left side of carapace, this being absent on the right side; this hepatic lobe protrudes eave-like laterally, above the lateral margin of carapace. On the apex of the dorsad of the hepatic area there are two, spaced, conical tubercles and obliquely in line with these are nine similar spinules or tubercles traversing the outer portion of the branchial region, while on the inner area of the branchial region there are about five to seven, isolated tubercles in approximate oblique series, the most posterior of which is the largest. The outer dorsal marginal portion of the branchial region is tumid and bears, on either side, two pairs of very large, triangular spines, one spine of each pair being dorsad to the other, the lower spine of each pair being the larger and protruberant over the rim-like lateral region; there is also a third spine or tubercle on the dorsad of the posterior branchial lateral region,

this being terminal to the aforementioned oblique series of dorsal, smaller tubercles.

The basal antennal article has a short, triangular spine at the external distal angle and a second, smaller tooth near, or on, the inner distal margin. Large old specimens bear a spine or denticle near the external angle of the buccal cavity.

The external maxillipeds are close-fitting; the meral article of the endognath is truncate distally, with distal outer angle rounded; the antero-inner angle emarginate.

The chelipeds are subequal, 33.5 centimeters long; the merus is subcylindrical, a trifle wider distad, with a prominent row of six to ten primary tubercles in longitudinal series on the upper surface, a similar row of seven or eight primary tubercles on the anterior lateral margin; several smaller spinules are scattered on the merus irregularly; the carpus is convex dorsally with two lines of small spines; the propodus and finger are 17.5 centimeters long, the finger being 6 centimeters of this total length; the propodus is 2.5 centimeters wide proximally and 3 centimeters wide distad; the fingers are slender, smooth, nude, separated proximally by a small, elliptical sinus, each with a large basal molar and eighteen to twenty smaller teeth in continuous series; the apices of the fingers are pointed, meeting.

The four pairs of ambulatories are quite long, strong, furred, with strong, acuminate dactyli, which are about .75 as long as the related propodi. The four pairs of legs successively decrease in length by about .2 of the length of the preceding pair.

REFERENCES: *Pericera ovata*, BELL, T., Proc. Zool. Soc. London, 1835 (1836), p. 173; Trans. Zool. Soc. London, 1836, vol. II, p. 60, pl. 12, figs. 5, 5o, 5p and 5q.

Stenocionops ovata, RATHBUN, M. J., Proc. U. S. Nat. Mus., 1910, vol. XXXVIII, p. 574.; Bull. CXXIX, U. S. Nat. Mus., p. 459, p. 574.—BOONE, L., Zoologica, N. Y. Zool. Soc., 1927, vol. VIII, p. 167, fig. 54.

Pericera macdonaldi, RATHBUN, M. J., Proc. U. S. Nat. Mus., 1892, vol. XV, pl. 29; *op. cit.* Bull. CXXIX, p. 460, pl. 268.

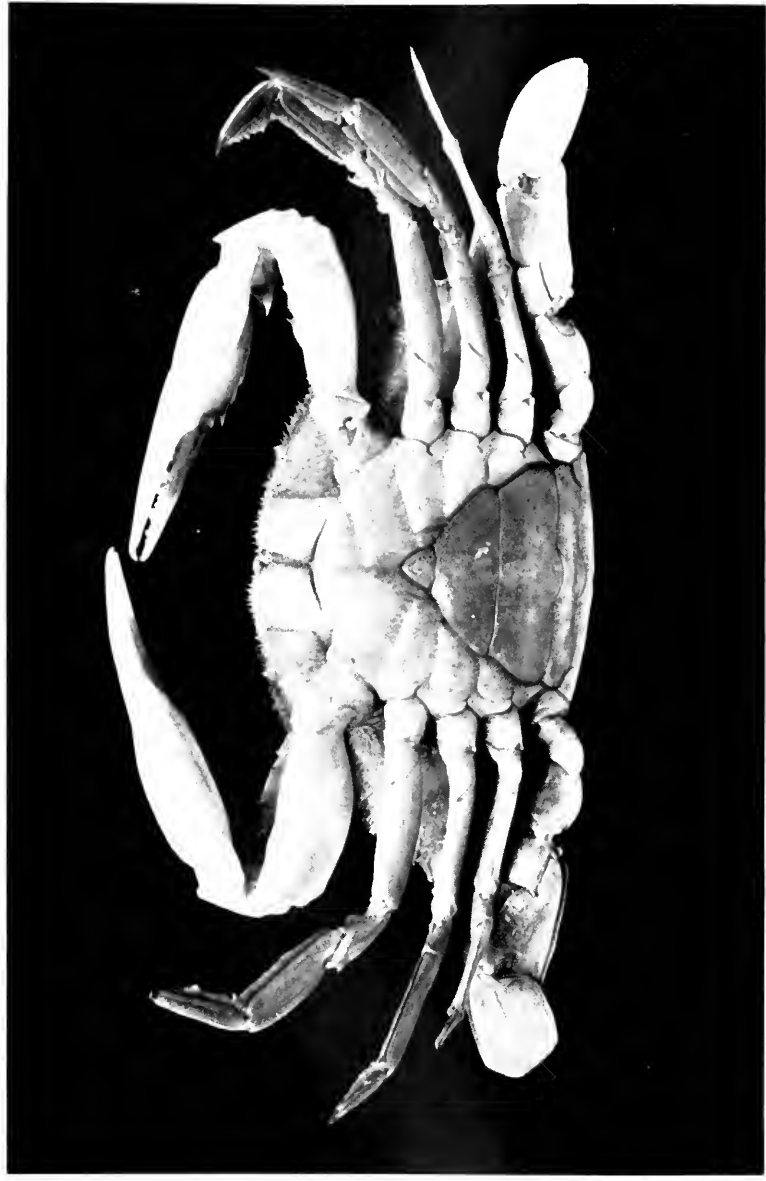
Pericera triangulata, RATHBUN, M. J., *op. cit.*, 1892, p. 246, pl. 32, fig. 1; *Ibid*, 1898, vol. XXI, p. 577; *op. cit.*, Bull. CXXIX, p. 461, pl. 165, fig. 1, pl. 266, fig. 1.



Neptunus sanguinolentus (Herbst), female, \times about 0.5, from Kewalo Bay, Oahu, Hawaii.



Neptunus sanguinolentus (Herbst), male, \times about 0.5, from Kewalo Bay, Oahu, Hawaii.



Neptunus sanguinolentus (Herbst), female, \times about 0.5, from Kewalo Bay, Oahu, Hawaii.

Family: **PORTUNIDAE**

Subfamily: **Lupinae**

Genus: **NEPTUNUS** De Haan

Neptunus pelagicus (Linné)

†

Volume V, plates 21, 22, 23, and 24

MATERIAL EXAMINED: Two large males and two females, collected at Manila, Philippine Islands, January 22, 1929, by the "Ara" World Cruise.

DISCUSSION: This exquisite swimming crab, here reported from the Philippines, where it was taken by the "Ara" World Cruise, was also taken in southern Australia, New Caledonia, the Dutch East Indies and Malay Straits, by the "Alva" World Cruise, 1931-1932, and has been fully described and figured by the writer, in Volume V, Bulletin of the Vanderbilt Marine Museum, 1934, p. 63, plates 21, 22, 23 and 24.

Neptunus sanguinolentus (Herbst)

†

Plates 81, 82, and 83

TYPE: Herbst's type was taken in the Orient and is deposited in the Zoological Museum at Berlin.

DISTRIBUTION: This crab has a very wide distribution in the Indo-Pacific regions, being known from the east coast of Africa eastward through the Indian Ocean and Pacific archipelagoes to the Hawaiian Islands. It has been repeatedly reported from the coasts of India, Ceylon, northward to Japan, down the Malay Straits and through the Sunda Isles.

MATERIAL EXAMINED: A large male and female, taken in Kewalo Bay, Oahu, Hawaii, December 16, 1928, by the "Ara" World Cruise.

TECHNICAL DESCRIPTION: This large species is the common edible crab of the Hawaiian Islands and of many other Pacific archipelagoes. The species' name, "*sanguinolentus*" refers to the three large, conspicuous, blood-red spots on the posterior area of the carapace. There is a Polynesian legend to the effect that

these "drops of blood" designate the crab as being marked by the blood of a chieftain or great warrior, who was slain at sea.

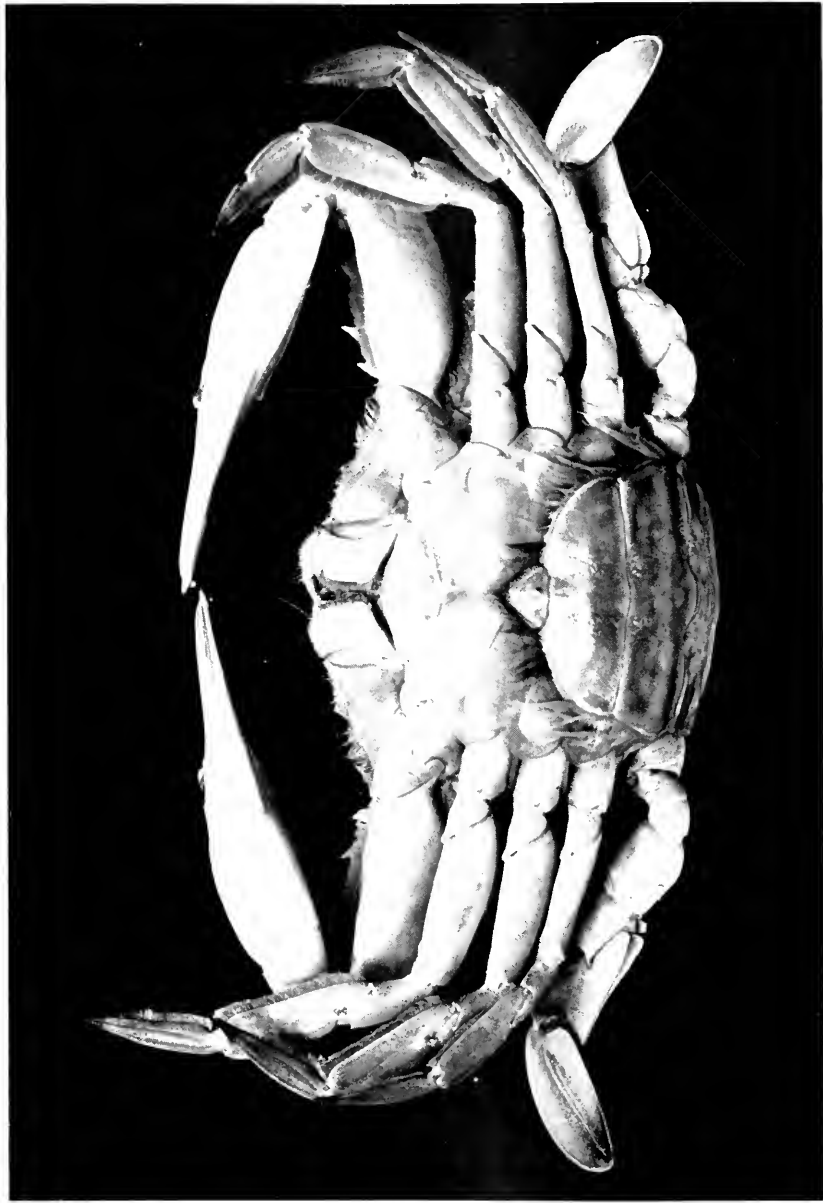
The carapace is quite broad, 0.5 as long as wide, exclusive of the great lateral spines, very slightly convex, finely granular on the anterior half, this being accentuated by three transverse lines of elevated granules, two of which are located on the gastric, and one on each of the branchial regions. The frontal margin is cut into four sharp, triangular teeth, in addition to the inner orbital angle, the median pair of these teeth being the less prominent; the spine-like process of the epistome projects much beyond these teeth. The supra-orbital margin is cut by two sinuses, the median lobe thus formed has rounded angles. The anterolateral margin is long and oblique, cut into eight triangular teeth in addition to the tooth-like external orbital angle, the lateral spine being from four to five times as long as the others. The posterior margin is smooth and curves confluent with the somewhat excavate post-lateral margins. The male belt is narrowed, triangular, consisting of five somites. The female belt is wide, subcircular, with the proximal three articles short, hinge-like, the fourth, fifth and sixth articles expanded, the seventh article small, triangular.

The external maxillipeds have the merus of the endognath with the outer distal angle not produced.

The chelipeds are subequal, those of the females and young males being about twice the length of the carapace, while those of large old males are two and a half times as long; slender, the merus with three to four spines on the upper lateral (anterior) margin, *but none on the posterior margin*; the carpus is decidedly spiniform at both the inner and outer lateral angles and has three incomplete carinae on the upper surface; the propodus is massive, as long, or slightly longer, than the fingers, with five carinae on the upper and outer surfaces and two on the inner surface; the uppermost carina of the outer surface terminates in a distal spine; the second carina is subparallel to the first and also in line with the upper marginal carina of the hinged finger; the third carina is about median, terminating distally in a spinose nodule at the base of finger; the third spine is proximal, in advance of the carpal joint, at the beginning of the third carina; the fourth carina is about midway between the third and the lower margin and continues the length of the lower finger; the fifth carina extends along the lower margin and also continues



Neptunus tuberculatus A. Milne Edwards, female, $\times 0.5$, from Aden, Arabian Sea.



Neptunus tuberculatus A. Milne Edwards, female, $\times 0.5$, from Aden, Arabian Sea.

on the finger. The fingers are slender, fluted, set with triangular teeth along the cutting edges.

The ambulatory legs are smooth, slender; the first and second pairs each have a subdistal spinule on the posterior margin of the carpal joint.

The Hawaiian specimens measure: Male, 55 millimeters long, 130 millimeters wide with lateral spines included; cheliped, 162 millimeters long. Female, 55 millimeters long, 128 millimeters wide; cheliped, 142 millimeters long.

REFERENCES: *Cancer sanguinolentus*, HERBST, J. F. W., Naturg. Krabben und Krebse, 1792, Bd. I, pt. II, p. 161, pl. 8, figs. 56-57.

Neptunus sanguinolentus, ALCOCK, A., Journ. Asiatic Soc. Bengal, 1899 (1900), vol. LXVIII, pt. 2, Nat. Hist., No. 1, p. 32 (with extensive synonymy).

Neptunus tuberculosus A. Milne Edwards

Plates 84 and 85

TYPE: The type was taken in the Sandwich Islands and is deposited in the Museum d'Histoire Naturelle, Paris.

DISTRIBUTION: This species appears to be rather sparsely represented in collections, there being less than half a dozen published records of it. In addition to the type from the Sandwich Islands, it has been reported by the "Challenger" from Arrow Island; from the Gulf of Martaban (Henderson) and from the Andamans, off Ceylon, 28 fathoms, and the Persian Gulf (Alcock); to these the "Ara" specimens add Aden.

MATERIAL EXAMINED: Two very large females, taken at Aden, Amha, Arabian Sea, March 7, 1929, by the "Ara" World Cruise.

TECHNICAL DESCRIPTION: The larger of the two females taken measures: carapace, 68 millimeters long, and 148 millimeters wide, with the lateral spines included; cheliped, 170 millimeters long. This specimen is shown in plates 84 and 85. It is in the process of ecdysis with the old carapace loosened along the posterior margin and the soft tissue of the new carapace visible. The

frontal margin is cut into four teeth, in addition to the prominent, tooth-like, preorbital angles, the median pair of teeth are greatly reduced, blunt and close together, the submedian pair, large, triangulate, subequal to the conspicuous preorbital angle and nearly as long as the first anterolateral tooth. The superior orbital margin is wide, incised by two, narrowed triangular sinuses, with the angles of these subacute. The postorbital tooth is a wide, conspicuous triangle, inbent toward the orbit, and somewhat longer than the adjacent anterolateral spine. The inferior preorbital spines are similarly prominent. The spinose process of the epistome is also much in advance of the median frontal spines, being nearly as long as those of the submedian pair. The anterolateral margin is widely convex, cut into eight, short, acuminate, slightly procurved, spine-like teeth, in addition to the postorbital tooth, the eighth, or lateral spine, being 2.5 times as long as the next adjacent spine, polished, acuminate, with a conspicuous line of beading extending inward from it across the branchio-gastric areas, as a continuous beaded line, which becomes less conspicuous in the median area. The dorsal surface is only moderately convex, with the cervical, gastric and cardiac grooves deeply impressed. The entire dorsal surface is paved with a series of conspicuous, low, rounded, granules, which are largest and most closely crowded on the central portion of the carapace, here forming the clustered granules into tuberclose groups, as shown in the illustration of the type; the granules becoming fewer on the anterior fourth of the carapace, yet remaining abundant and conspicuous here, extending even onto the lateral and frontal teeth. On the cardiac, mesogastric and inner branchial areas these large granules tend to form oval clusters. The posterior margin is carinate and confluent with the somewhat concave postlateral margins, this carina continuing on the latter to the base of the lateral tooth. Both the antero- and post-lateral margins bear a fringe of setae, which on the anterior margin fills the interstices between the teeth.

The external maxillipeds have the meral article of the endognath with the distal margins rounded, but not produced.

The basal antennal article fills the orbital sinus.

The eyes are large, with conspicuous, hemispherical, black, terminal cornea.

The chelipeds of the female are subequal, 170 millimeters long, with three, strong, procurved teeth on the anterior, upper meral margin and one distal spine at the terminus of the posterior meral margin; the carpus has three incomplete, unequal carinae on the upper surface, the outermost of which terminates in a sharp spine at the external carpal angle; the second of these carina is interrupted about two-thirds of the length of the carpus, but there is a small spinule on the distal carpal margin in line with this carina; there is a very strong spine at the inner carpal angle. The propodus is massive, high, slightly longer than the finger, decidedly costate, with the uppermost two carinae each terminating distally in a sharp spine; there is a third very strong spine at the proximal end of the third carina opposite the wrist joint; the fourth carina is midway the outer face of the palm and terminates subdistad to the base of the fingers; there is a conspicuous, red-brown circular spot above this carina, at the base of the fingers; the fifth carina is along the lower margin and continues to the tip of the lower finger. The fingers are subequal, long, slender, with triangular teeth; the acuminate apex of the lower finger extends beyond that of the upper one. The upper finger has three longitudinal carinae, the lower finger, two carinae, on their respective outer surfaces.

The second, third and fourth pairs of legs are slender, devoid of spines, decreasing in length in the order named. The fifth pair of legs are natatory, devoid of spines.

REFERENCES: *Neptunus tuberculosus*, MILNE EDWARDS, A., Archiv. du Mus. Paris, 1861, t. X, pp. 333, 339, pl. 31, fig. 5 (misabeled *N. rugosus*). — MIERS, E. J., Rept. H. M. S. "Challenger" Zool., 1886, vol. XVII, p. 176.—HENDERSON, J. R., Trans. Linn. Soc. London, Zool., 1893, ser. 2, vol. V, p. 369.—ALCOCK, A., Journ. Asiatic Soc. Bengal, 1899, vol. LXVIII, pt. II, Nat. Hist., No. 1, p. 42.

Subfamily: **Podophthalminae**Genus: **PODOPHTHALMUS** Lamarck**Podophthalmus vigil** (Fabricius)

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Volume V, plates 37 and 38

MATERIAL EXAMINED: Two fine male specimens, taken in Kaneohe Bay, Oahu, Hawaii, in 2 fathoms, December 16, 1928, by the "Ara." One large female, taken in Kewalo Bay, Oahu, Hawaii, December, 1928, also by the "Ara."

DISCUSSION: This strikingly beautiful crab is again reported in the Vanderbilt collections, this time from the Hawaiian Islands, from which archipelago it has previously been reported by Miers, Lenz, Gibbes, Randall and Rathbun. It was taken by the "Alva" World Cruise, 1931-1932, at Southport, Queensland, and is fully described and illustrated in Volume V, Bulletin of the Vanderbilt Marine Museum, p. 81, and plates 37 and 38.

Family: **CANCRIDAE**Subfamily: **Cancerinae**Genus: **CANCER** Linné**Cancer borealis** Stimpson

✓

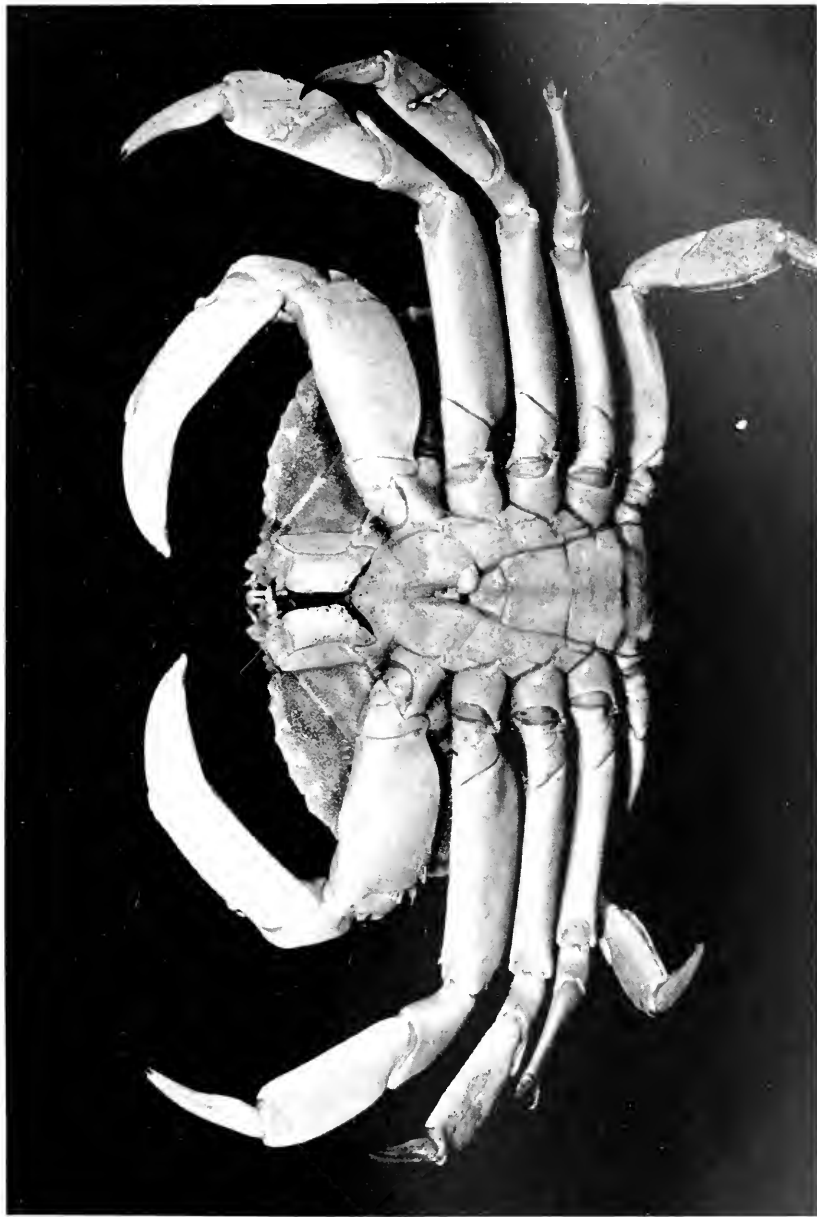
Plates 86, 87, and 88

DISCUSSION: This comparatively rare inhabitant of the shallow waters occasionally, but more usually of the greater depths, from Nova Scotia to the West Indies, was collected by Mr. Vanderbilt in the "Ara" dredgings of 1926, off Miami, Florida, in 1100 fathoms, and is fully described and illustrated in Volume II, Bulletin of the Vanderbilt Marine Museum, 1930, p. 148, pl. 49.

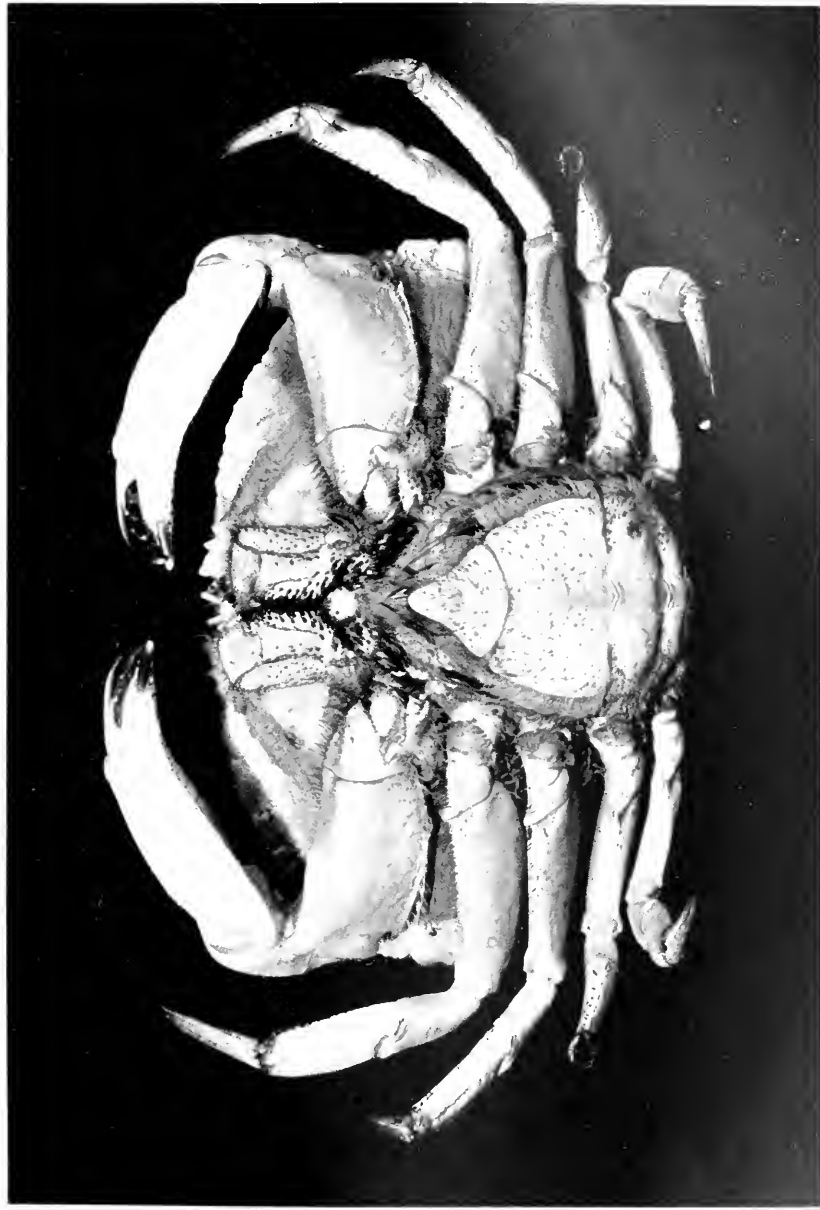
The present catch of seven specimens in one dredge haul off Fowey Rocks, Florida, would indicate that this crab may be gregarious. A typical specimen of both sexes is shown in plates 86, 87 and 88. The usual granulation of the carapace of *Cancer borealis* occurs in the four smaller specimens, which include both sexes, while the largest two females and larger male have the dorsad of the carapace coarsely granulose with several irregularly spaced,



Cancer borealis Stimpson, male, $\times 0.7$, from off Fowey Rocks, Florida, in 100 to 200 fathoms.



Cancer borealis Stimpson, male, $\times 0.7$, from off Fowey Rocks, Florida, in 100 to 200 fathoms.



Cancer borealis Stimpson, male, $\times 0.75$, from off Fowey Rocks, Florida, in 100 to 200 fathoms.



Cancer coronatus Molina, male, $\times 1.23$, from Ascencion Island, Chile.

very coarse granulations, some resembling tubercles, scattered chiefly on the outer branchial areas. This series of specimens shows the females to have the carapace slightly longer in ratio to the width, hence appearing more compact than do the males, which have the carapace a slenderer oval, this slender appearance being accentuated by the presence of much longer ambulatories than are possessed by the females.

All seven of the crabs bear several small barnacles each, these being more frequently attached to the carapace, although occasionally being found on the legs, or ventrad of the body. These barnacles represent a very rare species in various stages of growth, from specimens less than one millimeter long to some seven millimeters long, of *Poecilasma inaequilaterale* Pilsbry.

The carapaces of the seven crabs have the following dimensions, all expressed in millimeters:

<i>Width</i>	<i>Length</i>	<i>Sex</i>
107	67	Male
90	68	"
105	70	Female
100	68	"
108	80	"
102	74	"
90	57	"

MATERIAL EXAMINED: Seven specimens, two males and five females, dredged from four to two and one-half miles off Fowey Rocks, Florida (bearing 289° true to 273° true), in depths ranging from 200 to 100 fathoms, November 29, 1935.

***Cancer coronatus* Molina**

✓

Plate 89

TYPE: This species was first described by the Abbe Don Juan Ignacio Molina, a native of Chile and a very learned member of the Roman Catholic Order of the Jesuits, who was especially distinguished for his knowledge of the natural history of Chile, extensive collections of which he made during his residence in his

native country. Unfortunately, when the Jesuits were expelled from the Spanish Territories, the Abbe Don Molina shared the common fate and was also deprived of his natural history collections and his manuscripts. Some of the more important of the latter relating to Chile, he recovered quite accidentally after he established himself in Bologna, Italy. Here, in 1776, he published an anonymous compendium of the History of Chile and in 1782 his "*Saggio sulla Storia Naturale del Chile*" was published, in part, by the *Stamperia d. S. Tomaso d. Aquino*, Bologna.

The present writer has not been able to trace the depository of his types, if still extant. Their locality is here recorded simply as Chile, reference to the Abbe Don Molina's manuscripts, deposited in Bologna, Italy, being impractical. His brief description of the "*Cancer coronatus*," is given on p. 170, vol. I, "The History of Chile," English translation, 1809, under:

Crustaceous Fishes and Insects: "The crowned crab (*Cancer coronatus*) is furnished with a shell nearly oval, of about four inches and a half in diameter, with an excrescence in the center representing a mural crown." Though without an illustration, the Molina description of the delineation of the profile of a crown on the nearly oval carapace is entirely sufficient to identify the species, so well known from the long stretch of South American coast, from southernmost Chile, Port Otway, Valparaiso, Talcahuano, and Lota to Callao, Peru, and the name *Cancer coronatus* Molina should be given precedence over the more usually used *Cancer plebeius* Poepig, whose type, taken on the muddy shores of Chile, is deposited in the Zoological Museum at Leipzig.

DISTRIBUTION: Littoral zone of the coast of Chile, northward to Callao, Peru, and probably to the Bay of Panama.

MATERIAL EXAMINED: One male, collected at Ascension Island, Chile.

COLOUR: Not recorded from living specimens. There is nothing in his text to indicate that Mr. Bell's colour notes and exquisite plates were made from living specimens. In fact, the colour description for this species, given by him and quoted by subsequent writers, applies in detail to the spirit preserved specimens taken by the "Alva" three years ago, which are definitely known to have changed colour.

TECHNICAL DESCRIPTION: The carapace, which is wide, nearly oval, measures 110 millimeters greatest width and 63 millimeters

median length, with the interorbital region 16 millimeters wide, from tip to tip of the preorbital teeth. The preorbital margin is typically *Cancer*, with a narrowed, acuminate, median tooth, which is slightly longer than the closely adjacent similar, submedian pair, the apex of this median tooth extending only as far forward as does the margin of the second anterolateral tooth, while the submedian pair of teeth extend only as far forward as do the wider, blunter, preorbital teeth, from which they are separated by a wide sinus. The anterolateral margin is widely convex, cut into nine anterolateral teeth, of which the first, or postorbital, is usually slightly narrower than the second. The second, third, fourth and fifth and sixth teeth are each slightly wider than the preceding, this increase of width becoming distinctly more noticeable on the seventh tooth, which is quite one and one-third times the width of the sixth tooth and subequal to the eighth tooth, which is triangulate, crenulate distally, whereas the first seven teeth are truncated and crenulate; the ninth tooth is about as wide as the eighth but is unequally triangulate, the anterior margin being scarcely half so long as the posterior one. The tenth, or postlateral tooth, is about as wide as the ninth, from which it is separated by a deep notch, the distal border of the postlateral tooth being truncate, either separated posteriorly by a shallow notch, or sometimes continuous with the postlateral margin, which is sinuate-concave, continuous with the narrow posterior margin. The dorsal surface of the carapace is finely granulose, convex in both directions, with the gastric and urocardiac depressions well defined. The "crown" delineated on the dorsad of the carapace, is defined by a series of whitish (preserved specimen) dots which together outline the typical profile design of a crown. These dots are arranged in an arc (ten to twelve dots), across the anterior of the gastric region, which forms the median apex of the crown, laterally defined by the cervical groove, below which there radiate on either side, on the branchial region, two separate, widely curved lines of dots, defining respectively the outer lateral margin or band and adjacent inner band of the crown, which is augmented, on the inner side, by a shorter, less regular arc of dots, which curves inward to the short, strong, whitish line that arises in the gastro-cardiac line, these latter defining the innermost bands of the crown. This pattern is, in part, one of the colour-

ation, but the elevations and depressions in this region of the carapace also outline the profile of the crown.

The basal antennal article has a large, thick, triangulate tooth at the free angle, which is well advanced, protruding beyond the marginal contour of the carapace.

The external maxillipeds are close-fitting, concealing the epistome; the merus is truncate distally with the external angle rounded.

The chelipeds are subequal, the merus armed distally with two wide, sharp, triangular teeth, the smaller of which is at the anterolateral angle, the wider one at the postlateral angle and immediately behind this a third, subdistal, acute, triangulate tooth, approximately opposite to and nearly subequal to the anterolateral tooth; the carpus has a strong triangulate tooth at the inner distal angle, the upper and lower margins carinate, an interrupted nearly median carina and above this two weaker, short, oblique carinae; the propodus and dactyl are nearly 1.5 times as long as the merus, the height of the palm being about equal to half of its length, with the outer surface distinctly convex, the upper lateral margin carinate-dentate, with eight to twelve spine-like teeth; below this there are five longitudinal carinae on the face of the palm in addition to the carinate inferior margin; the first of these five carinae is carinate-dentate, but less so than the dorsal margin carina, and extends from the median angle of the carpus to above the median area of the dactyl; the third carina is a prominent ridge, extending the length of the palm and terminating near the inferior margin of the dactyl; the fourth carina is a distinct, but less prominent ridge which traverses the length of the palm and is continued as a stronger ridge along the upper surface of the lower dactyl near the base of the teeth; the fifth carina is similarly weak along the palm, but becomes a stronger carina along the lower half of the inferior dactyl, this carina persisting to the tip of the dactyl. The inferior margin of the propodus-dactyl is carinate and forms a wide arc. The upper finger is very curved and tapered with the upper margin quite convex, dentate, with seven to nine rough spinose teeth along the proximal three-fourths, extending about to the black colouration of the tip; the concave inferior margin is cut into about seven low, triangulate teeth, which are blackish, this black deepening towards the apex which is acuminate, closing upon the

wider, out-jutting apex of the lower dactyl. The cutting edge of the lower dactyl is similarly dentate to that of the upper one, the opposed teeth interfitting; a single larger tooth occurs distally on the lower dactyl.

The ambulatories are of the typical *Cancer* form, long, slender, laterally compressed, with dual carinae on the upper, outer surface of the carpus, a single carina on the upper surface of the propodus, the latter and more conspicuously carinate, the dactyl being longitudinally grooved on the outer face. The dactyl is about one-fifth to one-fourth longer than the related propodus, slender, curved, very acuminate, brown or blackish tipped.

The male belt has the third, fourth and fifth articles fused, but with lateral marginal notches indicating their original division; the distal article is narrowly triangulate with slightly concave lateral margins and acuminate apex.

The female belt is seven-segmented, more widely oval.

REFERENCES: *Cancer coronatus*, MOLINA, J. I., Saggio sulla Storia del Naturale del Chili, 1782, p. 207; French translation, by Gruvel, —, 1789, p. 183; English translation, Hist. of Chili, by English editor, London, 1809, vol. I, p. 170; an anonymous compendium of History of Chili, was published in Bologna, 1776.

Cancer irroratus, BELL, T., Proc. Zool. Soc. London, 1835, vol. III, p. 87; Trans. Zool. Soc. London, 1835, vol. I, p. 340, pls. 46, 47, figs. 6, 7.—HELLER, C., Reise "Novara" Zool., 1865, Bd. II, p. 6.—LENZ, H., Zool. Jahrb. Suppl. V, Bd. II, 1902, p. 759.

Cancer plebejus, POEPPIG, E., Archiv. f. Naturg., 1836, Bd. II, pt. I, p. 134.—KINAHAN, J. R., Journ. Royal Soc. Dublin, 1857, vol. I, p. 335.—MIERS, E. J., Proc. Zool. Soc. London, 1881, p. 67.—ORTMANN, A. E., Zool. Jahrb. Syst. 1893, Bd. VII, p. 425.—RATHBUN, M. J., Proc. U. S. Nat. Mus., 1898, vol. XXI, p. 581; *loc. cit.* 1910, vol. XXXVIII, p. 539, pl. 38, fig. 1; Bull. 152, U. S. Nat. Mus., 1930, p. 198, pls. 81, 82, fig. 1, pl. 85, fig. 3.

Platycarcinus irroratus, MILNE EDWARDS, H., et LUCAS, P. H., in d'Orbigny's, A. Voy. l'Amer. Meridionale, 1844, t. VI, pt. I, p. 19.—NICOLET, H., in Gay, C., Hist. fisica y polit. de Chile, Paris et Santiago, 1843-71, Zool., t. III, 1849, p. 142.

Cancer plebeius, DANA, J. D., in Wilkes, Chas., U. S. Explor. Exped., Zool., 1852, vol. XIII, pt. I, p. 155.—MILNE EDWARDS, A., Nouv. Archiv. Mus. Hist. Nat. Paris, 1866, t. I, p. 188.

Cancer edwardsii Bell

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Plates 90, 91 and 92

TYPE: Mr. Bell's type specimens, which apparently are no longer extant, were collected near Valparaiso, Chile.

DISTRIBUTION: This species inhabits the littoral zone of the west coast of South America, from southernmost Chile northward to Guayaquil, Ecuador. It has been reliably reported from Valparaiso (Bell); coast of Chile (Edwards); Talcahuano and Trinidad Channel (Miers); Talcahuano and Lota, Chile (Rathbun); Callao, Peru, (Kinahan); Guayaquil, Ecuador (Rathbun). The "Alva" catch adds two new records to the southern Chilean distribution of this crab.

MATERIAL EXAMINED: Two large females, dredged in 8 fathoms, in Bahia Ancud, Chiloe Islands, Chiloe Archipelago, Chile, February 9, 1935. A large male and female, in 9 fathoms, Port Lagunas, Chile, February 13, 1935, by the "Alva."

COLOUR: Not recorded from the living crab.

TECHNICAL DESCRIPTION: The carapace is a wide oval, very convex in both directions, except the rim-like margin. The narrow inter-orbital margin is not produced, being cut into three teeth in addition to the preorbital angles. The median tooth is the smallest, conical, scarcely or not at all advanced beyond the slightly larger, submedian, conical pair, which are separated by U-shaped sulci from the nearly subequal, blunt, preorbital teeth. The anterolateral margin is obscurely divided by closed fissures into nine teeth, each of these teeth being marginally crenulate or dentate, having variously two, three or even four indentations, some of which are bluntly conic, others truncate, faintly sinuate. The postorbital tooth is usually blunt, truncate. There is one strong postlateral tooth, which is usually weakly indented posteriorly. Behind this the postlateral margins form strong, sinuate carinae which terminate a little in advance of the wider, sinuate, flatly carinate posterior margin. The cardiac and anterior intes-

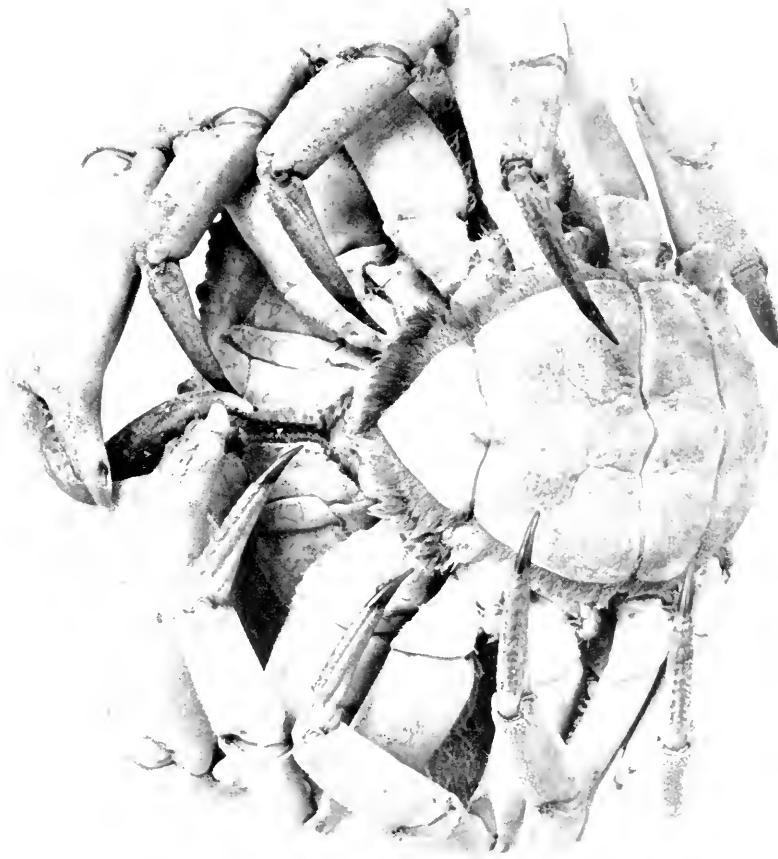


Cancer edwardsii Bell, male, $\times 0.65$, from Port Lagunas, Chile.

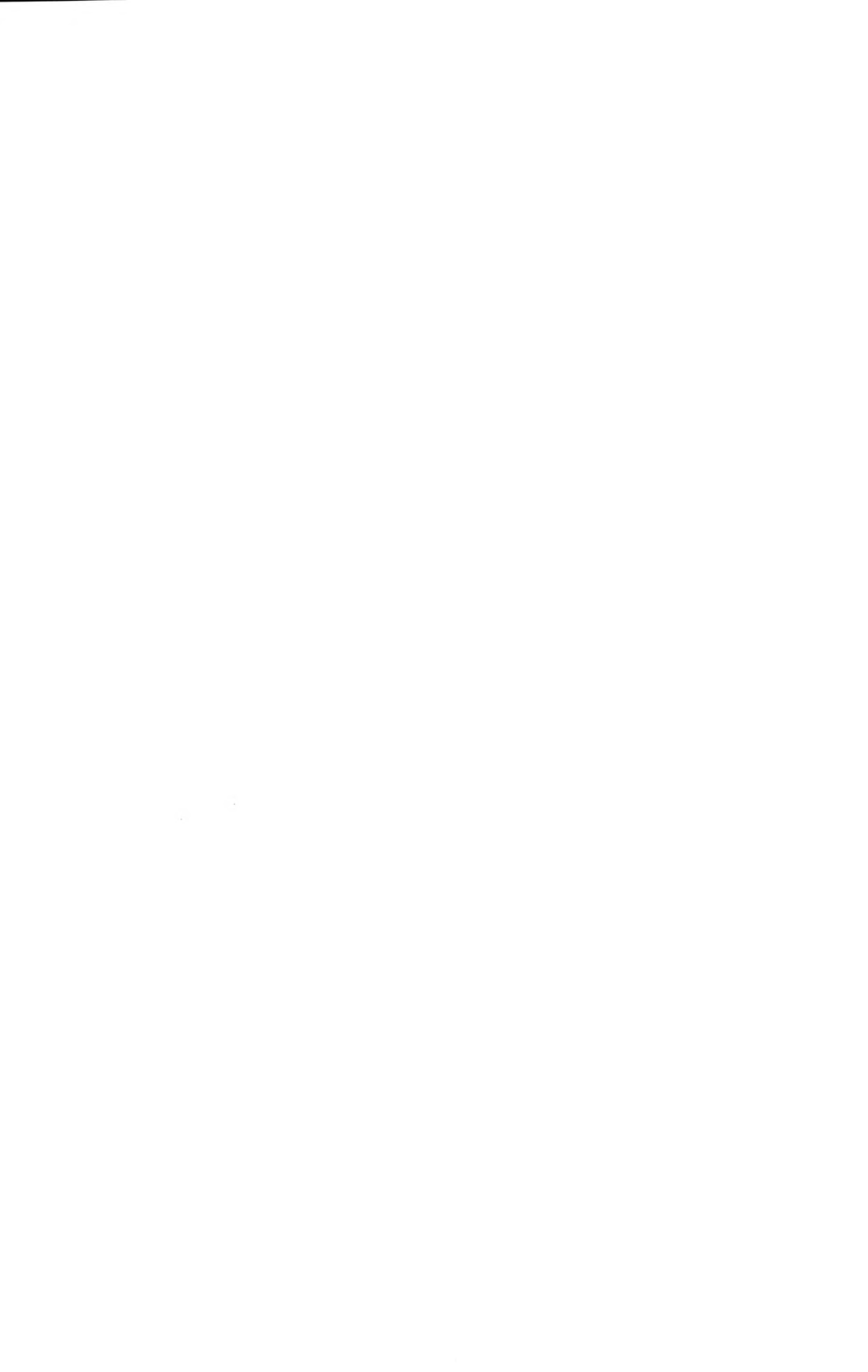


Cancer edwardsii Bell, male, $\times 0.65$, from Port Lagunas, Chile.





Cancer edwardsii Belle, female, $\times 0.65$, from Port Lagunas, Chile.



tinal regions are very definitely circumscribed, the cervical and hepatic grooves being rather obscurely impressed. The texture of the shell is coarsely granulose; the sidewalls of the carapace adjacent to the meri of the first three pairs of legs is furnished with a dense pilosity. The female abdominal belt is seven-segmented, widely oval, with the sixth somite much expanded; the seventh somite almost as long as the sixth, triangulate, with the slightly sinuate lateral margins converged to a rounded apex. The basal antennal article is subrectangular with the narrowed distal border truncate, thickened, blunt; the adjacent inferior orbital margin forms a small dentate lobe. The male belt is triangulate, as shown in plate 91.

The external maxillipeds are close-fitting, the merus of the endognath being nearly a third longer than wide, with the outer lateral margin oblique, forming a slightly rounded, somewhat obtuse angle with the anterior margin truncated, slightly convex.

The chelipeds are those of typical *Cancer*, with the merus trihedral, not extending beyond the carapace; the outer surface of the carpus broken by four incomplete carinae, the uppermost and next of which each terminate distally in a tooth. The palm, which is about four-fifths as high as long, is moderately inflated, the convex outer surface being traversed with seven longitudinal carinae, the uppermost two of which are broken into serial denticulation along the upper margin, the next three, non-dentate carinae terminating anteriorly behind the base of the upper finger, while the fifth and sixth carinae are slightly heavier and traverse the entire length of the palm and lower finger, terminating near the apex of the latter. The fingers are a little more than one-half of the length of the lower border of the palm and are partially separated by a narrow hiatus, the lower finger having five or six coarse teeth and the upper one three or four teeth. The black colouration extends nearly three-fourths of the length of the fingers from their apices in the females.

The ambulatories are rather stocky, not elongated, the merus triquetrous, the upper surface of the carpus traversed by two longitudinal carinae, separated by a wide sulcus; the propodus no longer than the carpus, not quite twice as long as wide, with a longitudinal groove on the posterior lateral face; the dactyl is very strong, as long as the related propodus, with the outer margin convex, the apex a very strong, acuminate tooth, both lateral

faces longitudinally fluted. The legs are devoid of bristles or pilosity.

REFERENCES: *Cancer edwardsii*, BELL, T., Proc. Zool. Soc. London, 1835, vol. III, p. 87; Trans. Zool. Soc. London, 1835, vol. I, p. 338, pls. 44, 47, figs. 2, 3.—DANA, J. D., in Wilkes, C., U. S. Explor. Exped., Crustacea, 1852, vol. XIII, p. I, p. 153 (*partim*).—KINAHAN, J. R., Journ. Roy. Soc. Dublin, 1858, vol. I, p. 336.—MILNE EDWARDS, A., Nouv. Arch. Mus. Hist. Nat. Paris, 1866, 1866, t. I, p. 193.—MIERS, E. J., Proc. Zool. Soc. London, 1881, p. 63.

Platyecarcinus edwardsii, MILNE EDWARDS, H., et LUCAS, P. H., in d'Orbigny's Voy. l'Amerique Merid., 1844, t. VI, pt. I, p. 20.—NICOLET, H., in Gay, C., Hist. Chile, Hist. fisica, nat. y polit. de Chile, Zool., 1849, t. III, pt. Crustacea, p. 144.

Cancer edwardsii, MIERS, E. J., Proc. Zool. Soc. London, 1881, p. 67.

Cancer edwardsii variety *annulipes*, MIERS, E. J., *op. cit.*, p. 63, p. 67.

Family: **GALENIDAE**

Genus: **GERYON** Kroyer

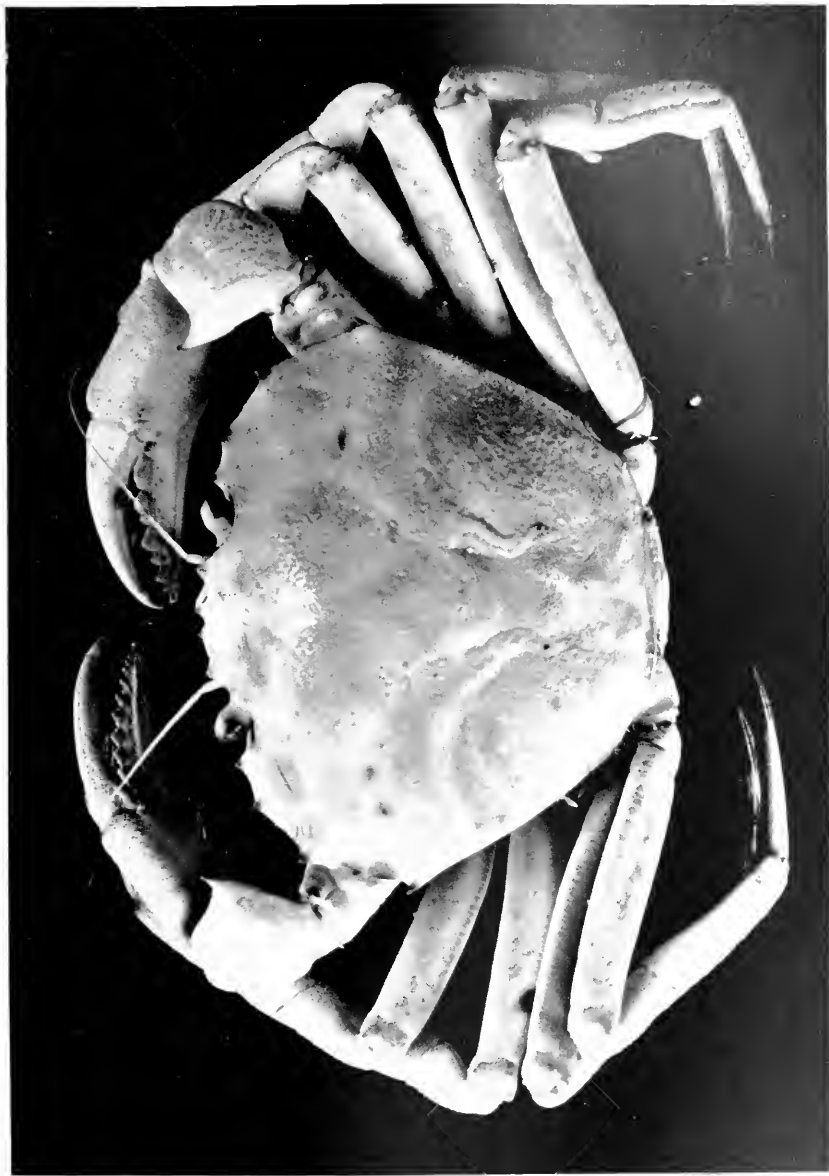
Geryon quinquedens S. I. Smith

✓

Plates 93, 94 and 95

TYPE: Professor Sydney Smith's type series was collected by the United States government steamer "Speedwell," off Casco Bay and off Massachusetts Bay, Gulf of Maine, and is divided between the United States National Museum and the Peabody Museum, Yale University.

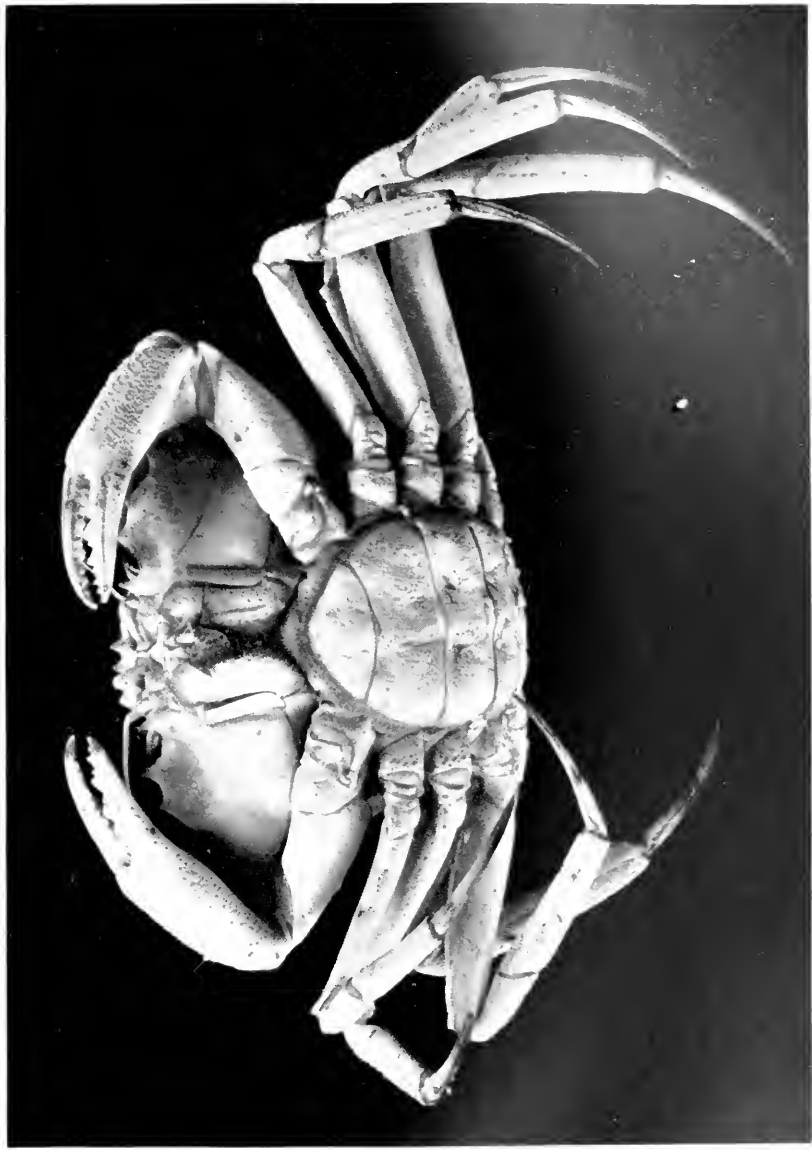
DISTRIBUTION: This species, which is very close to, but not identical with, the European *Geryon tridens* Kroyer, known from the deep water of boreal western European seas, has been repeatedly taken by the United States government explorations, in depths ranging from 22 to 1,178 fathoms, the occurrence being more frequently in the greater depths, at stations from off Nova Scotia southward as far as Cape Frio, Brazil. It was taken by the "Valdivia" at Saint Paul Island, in 2,068 meters (Doflein)



Geryon quinquepedons S. I. Smith, male, $\times 0.4$, from off Fowey Rocks, Florida,
in 100 to 200 fathoms.



Geryon quinquepedes S. I. Smith, male, ≈ 0.4 , from off Fowey Rocks, Florida,
in 100 to 200 fathoms.



Geryon quinquedens S. L. Smith, female, $\times 0.4$, from off Fowey Rocks, Florida,
in 100 to 200 fathoms.

and by the Prince of Monaco's expedition of 1902, at station 1311, Saint Miguel, Azores, by the "Princess Alice" (Bouvier).

MATERIAL EXAMINED: One large male and one medium size female, dredged by the "Alva," off Fowey Rocks, Florida, bearing 289° true, four miles distant to bearing 273° true, two and one-half miles distant, in 200 to 100 fathoms, November 29, 1935.

COLOUR: In life this crab is a vivid "deep-sea" crustacean scarlet, with the dactyli a darker russet; the setae of the mouth-parts are a golden brown.

TECHNICAL DESCRIPTION: The male has the following measurements, all expressed in millimeters: carapace, 125 long; 150 maximum width, across the anterolateral spines; 95 minimum width across the posterior margin; frontal margin, 30 wide; the orbit, 25 wide. The cheliped is 282 long, the first ambulatory leg, 285, the second and third legs each 290 and the fourth leg, 285 long. The female carapace is 90 long, 110 maximum width, and 65 minimum width, with the chelipeds much smaller, measuring only 95 millimeters long.

The carapace is high, xanthid-form, about five-sixths as long as the maximum width, very convex longitudinally, especially on the anterior half, but only slightly so transversely, with the inter-orbital margin one-fifth of the maximum width, produced into a pair of median teeth, separated from each other by a concave sulcus only two-thirds as wide as those separating the median teeth from the broader preorbital angle, which is protruberant, very conspicuous. The orbit is 30 millimeters wide, with the upper margin concave, entire, faint lines indicating the two closed sinuses; the superior postorbital angle is an acute, spinose triangle. The anterolateral margin of the carapace is short, convex, beaded and cut into four teeth, in addition to the postorbital tooth, these being unequally distributed. The first tooth is a short point, not quite so strong as the postorbital tooth from which it is separated by a very shallow, concave arc of 12 millimeters width; the second tooth is 1.5 times as far from the second as the latter is from the first, or is approximately midway the anterolateral margin; the margin between the second and third teeth is cristate, scarcely at all convex; the fourth tooth is practically obsolete in the large male specimen, being represented by a mere denticle on the margin, located not quite halfway between the third and fifth teeth; the fifth tooth is acute, spinose, prominent. The post-

lateral margins, which are 1.5 times as long as the anterolateral margins, are sharply delineated, granulose, posteriorly convergent. The posterior margin is 75 millimeters long, carinate. The sidewalls of the carapace are high, smooth, the pterygostomial channel deep. The areolae of the carapace are distinctly defined, the sulci shallow, but definite, except the urogastric pits, which are deep. The mesogastric, epibranchial and mesobranchial areas are moderately convex and are paved with numerous large, flat-tish, rounded granules interspersed with coarse punctae. Similar granulose patches are conspicuous on the upper half of the carpus and palm of the chelipeds.

The antennular fossa is separated medially by the epistome process. The basal antennular article is much enlarged, triangular, with this outer angle and lateral margin distally produced, partially closing the orbital sinus. The second antennal article is rectangular and is situated between the basal antennular article and the orbital tooth.

The external maxillipeds are close-fitting, with the ischial articles of the endognath very setose along the inner lateral margins; the merus is distally truncate with the angles not produced.

The male belt is seven-segmented, triangular, moderately wide. The female belt is widely oval, composed of seven somites.

The female carapace has the third spine of the anterolateral margin entirely obsolete on the left side, but on the right side this spine is more distinctly developed than are either of those on the male specimen.

The chelipeds are slightly unequal in the male, the right one being the larger in the present specimen, the difference being chiefly apparent in the more massive palm. The merus is strong, trigonal, with both the upper lateral margins carinate and the posterior lateral margin with a subdistal node; the inferior margin ends in a coarse, blunt, protruberant node. The carpus is convex with a very strong, acute tooth at the inner lateral angle, and the upper surface coarsely granulose, as are also the propodus and proximal portion of the finger. The palm is as high at the base of finger as the upper margin is long, with the upper and outer surfaces convex and a faint sulcus on the upper half of the outer surface and two vague submedian costae, the lower of which is much more definite and granulose, terminating near

the base of the fingers. The fingers are each nearly as long as the palm, fluted, distally tapered, each with a coarse molar and five or six coarse triangular teeth. The female chelipeds are much smaller than those of the male and are subequal.

The ambulatory legs are very long, decreasing in the order: 2 equals 3, 1, 4, with the merus, carpus and propodus laterally compressed, the latter two articles with two or three longitudinal lines of coarse punctae on the outer faces; the dactyli are strong, 0.9 as long as the propodi, laterally compressed, distally tapered, fluted longitudinally and very acuminate.

REFERENCES: *Geryon quinquedens*, SMITH, S. I., Trans. Conn. Acad. Arts and Sci., 1879, vol. V, p. 35, pl. 9, figs. 1-1a.—BOUVIER, E. L., Res. Campagn. Sci. Monaco, 1922, Fasc. LXII, p. 70, pl. 6, fig. 7.—RATHBUN, M. J., Bull. CXVI, U. S. Nat. Mus., 1937, p. 271, pls. 85, 86.

Geryon paulensis, DOFLEIN, F., Exp. "Valdivia," Brachyura, 1904, p. 112, pl. 31, figs. 31 and 32.

Family: **GRAPSIDAE**

Subfamily: **Grapsinae**

Genus: **GRAPSUS** Lamarck

Grapsus grapsus Linné

Volume II, plate 69; Volume V, plate 90

MATERIAL EXAMINED: Four females and two males, of small and medium size, taken at Jebwar, Jaluit Island, Marshall Islands, December 30, 1928, by the "Ara" World Cruise.

DISCUSSION: Again the scarlet *Grapsus grapsus* is recorded in the Vanderbilt collections, the present series apparently establishing the first record of its occurrence in the Marshall Islands. The specimens, which are of medium and small size, are identical in diagnostic characters with the several hundred previously examined by the writer from various, widely scattered localities in the tropicopolitan regions this species inhabits. It has been completely described with illustrations in Volume II, Bulletin of the Vanderbilt Marine Museum, 1930, p. 203, plate 69, also Ibid, Volume V, 1934, p. 178, plate 90.

Genus: GEOGRAPSUS Stimpson

Geograpsus lividus (H. Milne Edwards)

†

MATERIAL EXAMINED: Seven females and one male, taken at Jebwar, Jaluit Island, Marshall Islands, December 30, 1928, by the "Ara" World Cruise.

DISCUSSION: Again the graceful little scarlet shore-crab, *Geograpsus lividus* appears, this time skittering with inimitable gracefulness among twisted roots of the wind-sculptured trees of the tidal zone of the Marshall Islands, an entirely new locality for it, which extends the known geographic range much farther west in the Pacific, the nearest archipelago from which it is known being the Hawaiian Islands. The type was described from the "Antilles" by Dr. Henry Milne Edwards (1837) and is deposited in the Paris Museum d'Histoire Naturelle. It is well known on both the eastern and western coasts of the Americas, in the subtropic and tropic areas, from the Bermudas and southern Florida to Sao Paulo, Brazil, also from the Cape Verde Islands, in the Atlantic, and from Lower California to Chile, on the Pacific coast. It was also taken in the Galapagos Islands by Dr. William Beebe, director of the "Arcturus" expedition, 1925-1926, of the Tropical Research Station, of the New York Zoological Society, and is fully described and figured by the present writer in *Zoologica*, N. Y. Zoological Society, 1927, vol. VIII, art. 4, p. 252, figure 91.

The present material is diagnostically identical with numerous specimens from both east and west American localities, examined by the writer, some of which material was directly compared with the type. The Marshall Islands specimens are typical *lividus*, and hence are not to be confused with the variety *stormi* de Man² reported from other eastern archipelagoes.

²*Geograpsus lividus* variety *stormi* de Man, J. G., Zool. Jahrb. Syst., 1895, Bd. IX, p. 88; Ibid, Bd. X, pl. 28, figs. 18-a and c.



Sesarma (*Sesarma*) *rotundatum* Hess, male, $\times 0.98$, from Kusaï Island, Caroline Islands.

Subfamily: **Sesarminae**

Genus: **SESARMA** Say

Sesarma (*Sesarma*) **rotundatum** Hess

✓

Plate 96

TYPE: Herr Hess described this *Sesarma* in 1865 from a specimen collected in Sydney, New South Wales, and deposited in the Gottingen Zoological Museum.

MATERIAL EXAMINED: One male, collected on Kusai Island, Caroline Islands.

DISTRIBUTION: This very active little crab of the littoral zone of the Indo-Pacific probably has a much wider and more abundant distribution than is indicated by published records, the paucity of the latter probably being due to the agility and speed the crab shows in escaping collectors. The following records for it have been published: Sydney, New South Wales (Hess); Philippines (de Man); Seleo, Berlinhafen, New Guinea (Nobili); Eastern Seas, Duke of York Island, Nairai, Fiji Islands (Miers); Funafuti, Ellice Islands, and Rotuma (Borradaile); Aru Atoll and Ebon, Marshall Islands (Rathbun); Upola, Samoa (Milne Edwards); Kusai Island, Caroline Islands (Boone); and Oahu, Hawaiian Islands (Rathbun).

TECHNICAL DESCRIPTION: This single specimen from Kusai Island is a male, the carapace of which measures 42.5 millimeters long and 45.5 millimeters wide; the longest ambulatory measures 100 millimeters total length, with the meral joint 32 millimeters long and 10 millimeters greatest width. The carapace is longitudinally convex on the anterior half, also on the entire lateral areas, the four post-frontal lobes being prominent, unequal, beaded. The regions of the carapace are distinctly defined, the protogastric aerolations being tumid, separated from the anterior branchial areas by a wide cervical groove which terminates anteriorly in a deep depression behind the orbit and is posteriorly confluent with the deep-pitted urogastric depression. The mesogastric, cardiac and intestinal regions are separately circumscribed; the epi-branchial regions are convex, with the oblique striations, characteristic of this genus, faintly but definitely outlined in the Kusai specimen. The deflected region is 18 millimeters long, 6 milli-

meters deep, approximately rectangular, with the two long margins faintly sinuate, the upper margin beaded, faintly quadrilobate, the lower margin laminate, faintly bilobed, the angles nearly right angles faintly rounded; the surface of this frontal area is concave in both directions. The superior orbital margin is entire with the postorbital angle a sharp, triangular tooth behind which there are two successively weaker teeth on the lateral margin, which itself forms a thin carina throughout the entire length and is posteriorly confluent with a similarly carinate posterior margin. This second lateral tooth is sometimes quite rudimentary. The anterior half of the carapace is ornamented with frequent coarse flattish irregular tubercles, these becoming smaller posteriorly and being replaced on the lateral area by oblique striations. The pterygostomian region is covered by a reticulation of regularly spaced fine tubercles, semiconcealed beneath the coarse, regularly spaced pilosity. The male abdominal belt is seven-segmented, triangular.

The male chelipeds are equal, large, the merus being trihedral, with the three margins coarsely granulose or dentate, with an enlarged, subdistal tooth on each lower margin; the carpus is convex and granulose on the outer face, with the inner margins coarsely beaded or spinose and a strong, slender spine at the inner angle; the propodus is enlarged, with its length on the lower margin equal to three-fifths of the greatest width of the carapace; the height of the palm is equal to five-sixths of the length of the lower margin of the palm; the lower finger being three-fifths as long as this lower margin and continued in the same plane, but incurved distally. Both the inner and outer surfaces of the palm are quite convex and are covered with numerous coarse, usually round or sometimes sharp granules, spaced irregularly and not so close together; these granules form a distinct beading along the upper margin and are continued on the upper and lower proximal areas of the two fingers, also distally in a linear series. The lower finger is the shorter, triangular, incurved distally, separated from the upper one by an oblique hiatus, which is oval proximally, nearly linear distally. The inner base of the lower finger is furnished with numerous tufts of bristles, filling in this hiatus; the remainder of the cutting edge bears eight to ten teeth, the third from proximal of which is much the larger; the apices of the fingers are rounded, spatulate.

The upper finger is swung obliquely, hence is the longer, being the more slender of the two distally, with the entire cutting edge dentate, set with thirteen to fifteen teeth, the most proximal of which is the largest.

The ambulatories are long and slender, decreasing in the order 3, 2, 1, 4, the third pair being 2.3 to 2.5 times the length of the carapace. Each leg has the merus unequally triquetrous, the lower surface being the least, this widening distally and being margined laterally by thin carinae, which also form, respectively, the lower margins of the two lateral faces; the dorsal surface of the merus widens a little gradually, the two margins are laminate, the lower distal angle rounded, the upper margin terminating in an acute, subdistal tooth; the carpus is somewhat clavate, three-fifths as long as the merus, with the upper margin ridge-like, paralleled by a groove, also by a second lesser ridge on the dorsal upper half; the lower margin is also laminate; the propodus is five-sixths as long as the merus, with the upper or outer lateral margin carinate, a shallow, longitudinal groove on the outer face, the lower lateral margin furnished sparsely on the proximal half, and abundantly so on the distal portion, with a dense, blackish pilosity; this brush decreasing from a distally wide one on the first ambulatory to a slender one on the fourth ambulatory leg. The dactyli are similar, short, triangular, very acuminate distally, that of the third leg being one-third as long as that of the propodus. Each dactyl has the narrowed margin thickened and furnished with a dense, pilose brush of blackish setae, the two halves of the outer brush being longitudinally separated by a linear bare area; the outer brush being similarly separated from the inner brush by a narrow area of the lateral face which bears spaced tufts of bristles. The first and fourth dactyli are each about two-thirds as long as the related propodus, while those of the second and third pairs of legs are, respectively, one-third as long as the related propodus.

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- Sarmatium faxoni*, RATHBUN, M. J., Bull. U. S. Fish. Comm. for 1903 (1906), vol. XXIII, pt. III, p. 841, pl. 7.
- Sesarma (Sesarma) rotundatum*, RATHBUN, M. J., Mem. Mus. Comp. Zool., vol. XXXV, 1907, p. 33.

Family: GECARCINIDAE

Genus: CARDISOMA Latreille

Cardisoma hirtipes Dana

†

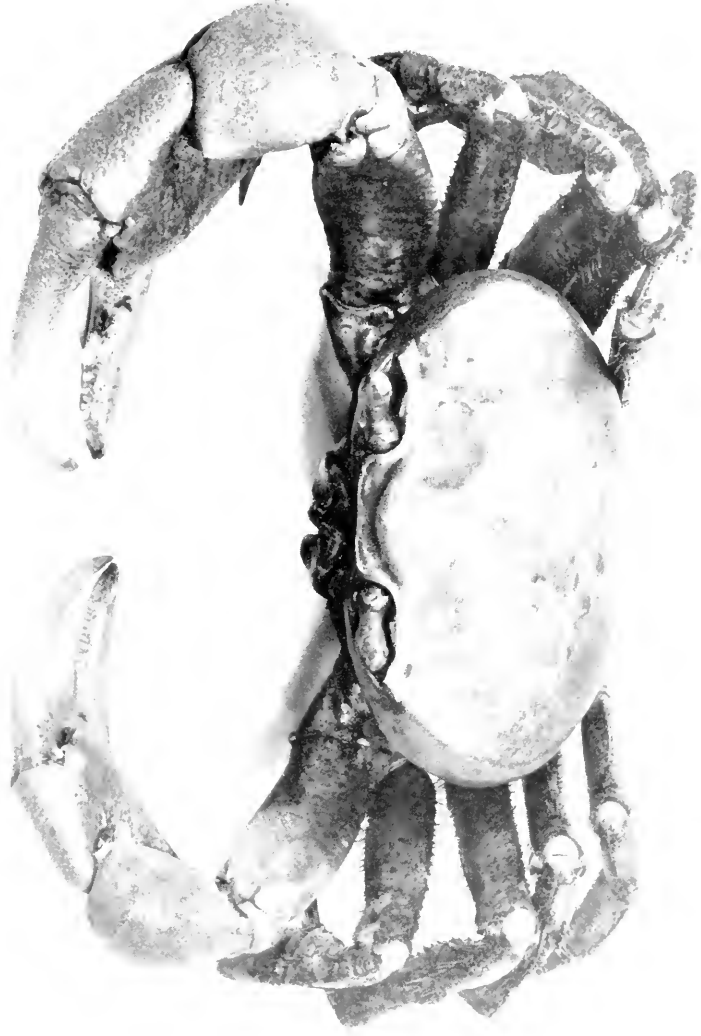
Plates 97 and 98

TYPE: Prof. Dana's type, a male specimen, was collected in the Fiji Islands and deposited in the Philadelphia Academy of Natural Sciences.

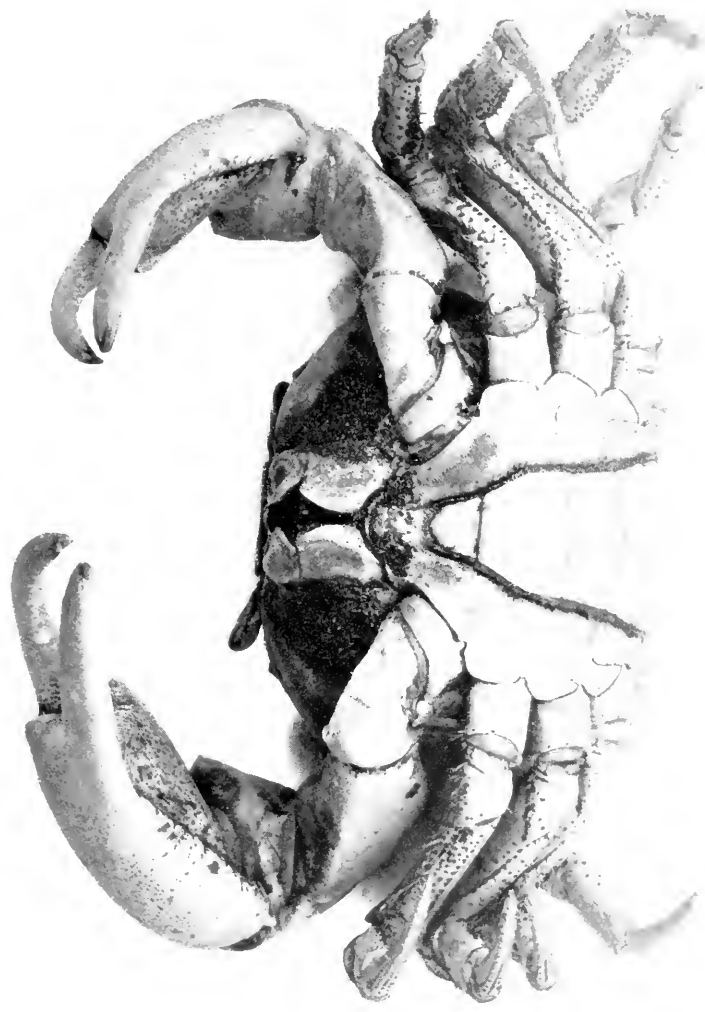
DISTRIBUTION: This species, which is terrestrial and in the breeding season and larval stages littoral in the Indo-Pacific, has been recorded from the following places: South Seas, Madagascar (Alcock); New Caledonia (Milne Edwards); Nicobar Islands, Andaman Islands (Alcock); Mauritius, South Sea (Ortmann); New Zealand (Filhol); Sydney, New South Wales (Hess); Fiji Islands (Dana); Funafuti, Ellice Islands (Whitelegge); Amboina (Nobili); Amboina, Ternate, Morotai and Edam Island (de Man); Tahiti (Heller); and Kusai Island, Caroline Islands (Boone).

MATERIAL EXAMINED: One male, taken on Kusai Island, Caroline Islands, January 2, 1929.

COLOUR: Dr. Alcock states that in life the carapace of this species is dark violet and the chelipeds are bright cinnabar red. The single specimen brought home by the "Ara" retains this colour pattern, though somewhat faded.



Cardisoma hirtipes Latreille, male, about two-thirds of natural size, from Kusai Island, Caroline Islands.



Cardisoma hirtipes Latreille, male, about two-thirds of natural size, from Kusai Island, Caroline Islands.

TECHNICAL DESCRIPTION: In the field this species is readily distinguished from *Cardisoma carnifex* (Herbst), which is found in the same regions, by the rich violet-purple colouration of the carapace and the bright cinnabar red of the chelipeds of *Cardisoma hirtipes* Dana.

The characters which distinguish Dana's *hirtipes* from the older Herbst species *C. carnifex*³ are the following:

I. The carapace of *Cardisoma hirtipes* is noticeably less convex, the regions are more sharply defined by deeper, wider grooves; this is especially apparent in the gastric region, where the grooves divide it into three areolae, a median and two lateral, the smaller hepatic lobes, outside the latter, being similarly circumscribed; on the sides of the epibranchial regions there are some fine, oblique striations.

II. The greatest width of the orbital cavity of *hirtipes* is from three-fifths to two-thirds of the length of the orbital cavity; the inner margins of the orbit, formed by the deflected sides of the front of the carapace, are not nearly so oblique; the superior orbital margin is less sinuous and extends slightly forward and downward, uniting with the external orbital angle. The basal antennal joint is smaller and does not touch the front.

III. The buccal cavern is longer than wide, the width measured across the middle of the meral articles of the external maxillipeds being only 0.8 of the length of the cavern measured in the median line.

IV. The inequality of the chelipeds is decidedly less in *C. hirtipes*; the chelipeds being more frequently equal than unequal, even in the large old specimens, which usually have the palms enlarged and the related dactyli long.

V. The ambulatory legs are more abundantly furnished with tufts of stiff bristles which occur along the entire anterior margin of the merus.

VI. The male abdominal belt of *C. hirtipes* has the distal (seventh) somite more than 0.5 as long in the median line than the preceding (sixth) somite in the present specimen from Kusai Island.

The carapace is convex longitudinally, five-sixths as long as wide, the regions sharply defined by deep grooves, the areolae

³Recently redescribed and figured in Vol. V, Bull. Vanderbilt Marine Mus. 1934, p. 187, pls. 97, 98.

elevated, smooth, except for coarse punctae, the lateral margins defined carina-like anteriorly, this terminating in a small denticle anteriorly. The sidewalls are high, the pterygostomian region covered with a short, coarse, thick pilosity. There is a small, triangular, trihedral process between the orbit and the outer antennae. The first article of the external antenna is subrectangular, distally truncate; the second article is small, distally sinuate, not quite touching the front.

The chelipeds, moderately unequal in this old male specimen, have the merus trihedral, the carpus with the upper surface roughly four-sided, with a sharp, wide triangular tooth at the inner distal angle (this angle being less conspicuous on the smaller cheliped; the propodus is as long on the lower margin as the greatest height of the palm, the outer surface being moderately convex transversely; with the lower dactyl two-thirds as long as the lower margin of the palm, triangular, with one large tooth and two or three smaller ones on the distal half; the upper dactyl is longer, slenderer, swung obliquely, with the outer margin convex, the cutting edge separated by a wide oval hiatus from the lower finger, the blunted apices only meeting; a single median tooth and several rudimentary denticles distally. The opposed smaller propodus and finger are similar except in size, the hiatus being distinctly narrower and the teeth all very small or absent.

The ambulatories are strong, stout, the distal four articles being very abundantly furnished with bristles, these being placed on all three edges of the trihedral merus, one dorsal and two ventral; also in three longitudinal series on the upper face of the carpus; on the dorsal and ventral margins of the propodus, and on the dactyl, which is one and one-half times as long as the propodus, has the outer margin flat, armed with a double series, each consisting of ten to twelve sharp spines, the two rows being separated by a linear groove bearing tufts of bristles; the inferior margin of the dactyl is similarly flat, with a double series of spines separated by a median groove set with bristles; the apex is strong, sharp, nail-like.

REFERENCES: *Cardisoma hirtipes*, DANA, J. D., Proc. Acad. Nat. Sci. Phila., 1851, p. 253; in Wilkes, C., U. S. Explor. Exped., 1838-42, Crust., 1851, vol. XIII, p. 376, atlas, for vols. XIII-XIV, pl. 24, figs. 2-a-d.—MILNE EDWARDS, H.,

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- Discoplax longipes*, MILNE EDWARDS, A., Ann. Soc. Entomol. France, 1867, ser. 4, t. VII, p. 284; Nouv. Archiv. Mus. Hist. Nat. Paris, 1873, p. 294, pl. 15.

Family: OCYPODIDAE

Subfamily: Ocypodinae

Genus: UCA Leach

Uca annulipes (Latreille)

✓

Volume V, plates 101 and 102

MATERIAL EXAMINED: Seven males and three females, taken at Kusai, Caroline Islands, Pacific Ocean, January 1, 1929, by the "Ara" World Cruise, apparently established the first record of this species in the Carolines.

DISCUSSION: This is the fascinating little burrowing crab of the tidal zone of the Indo-Pacific region, personified in the legends of many peoples variously—as a worshipper of the tides, as a warrior escaped from shipwreck, or in other roles. It is known from the Red Sea to South Africa, also eastward from the Red Sea, through the Indian Ocean Archipelagoes, Philippine Islands, Dutch East Indies, Borneo, the Australian coast, and numerous archipelagoes of the South Central Pacific eastward to the Society Islands and now adds another archipelago—the

Caroline, from which the "Ara" record is apparently the first. It was also taken by the "Alva" World Cruise at Noumea, New Caledonia, and is fully described and figured in Volume V, Bulletin of the Vanderbilt Marine Museum, 1934, p. 194 and plates 101 and 102. The specimens from Kusai Island are of assorted sizes, ranging from several about equal to those shown in plate 101 to very young adults, only half so large.

REFERENCES: *Uca annulipes*, BOONE, LEE, Bull. Vanderbilt Mar. Mus., 1934, vol. V, p. 194, pls. 101, 102. (Complete analysis).

Order: **MACRURA**

Family: **SCYLLARIDAE**

Genus: **SCYLLARIDES** Gill

Scyllarides aequinoctalis (Lund)

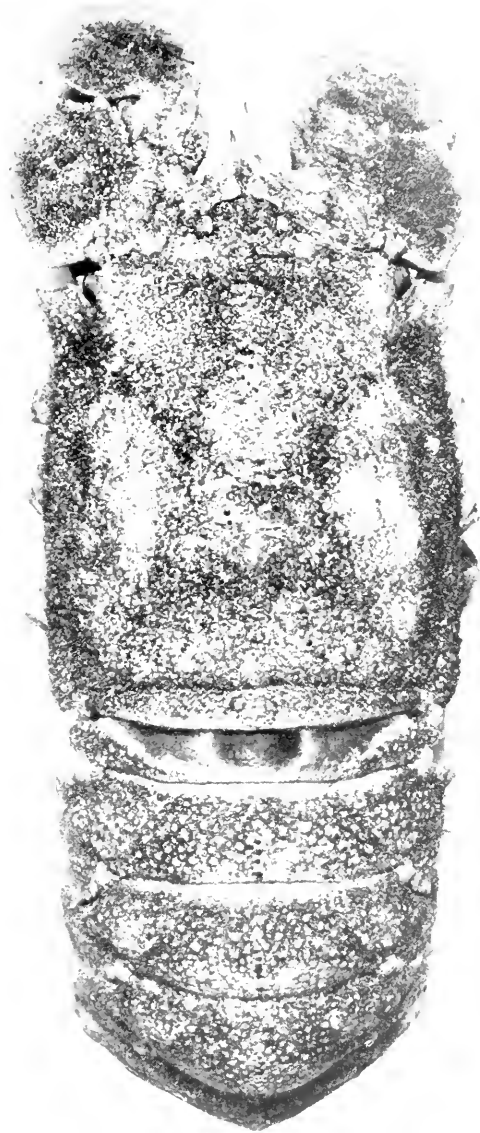
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Plates 99 and 100

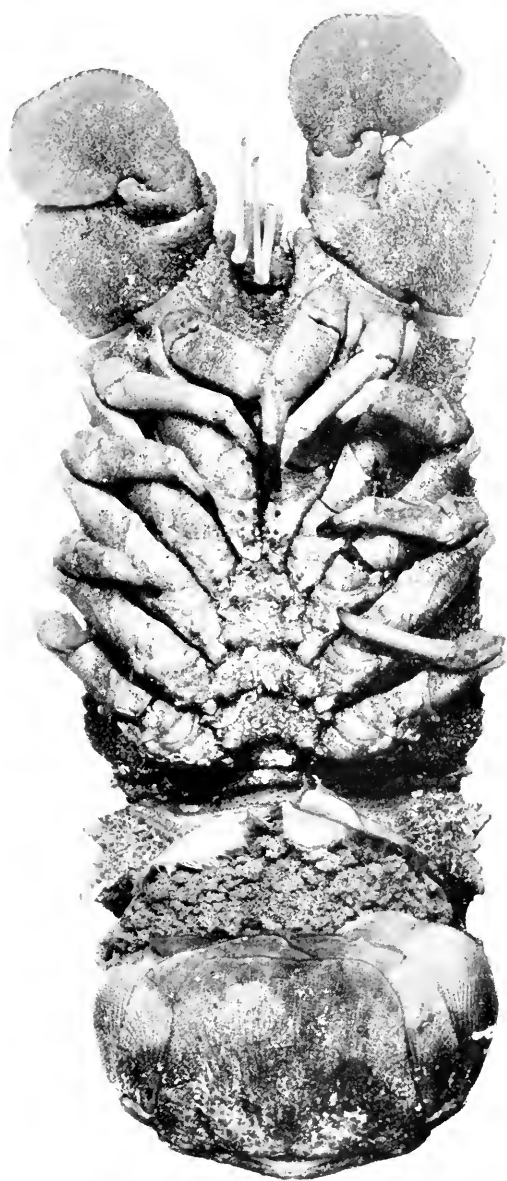
MATERIAL EXAMINED: One male, 30 centimeters long, and one ovigerous female, 29 centimeters long, taken at Funchal, Madeira, June 29, 1933, by the "Alva" Mediterranean Cruise.

DISTRIBUTION: The bathymetrical occurrence of this species is considered to be from littoral down to 100 fathoms, but with most of the dependable records citing comparatively shallow water occurrences. The larval form is highly interesting and undergoes the usual macruran pelagic, planktonic stages. The adult has been several times reported in the West Indies and is here recorded from Madeira and the Galapagos Islands.

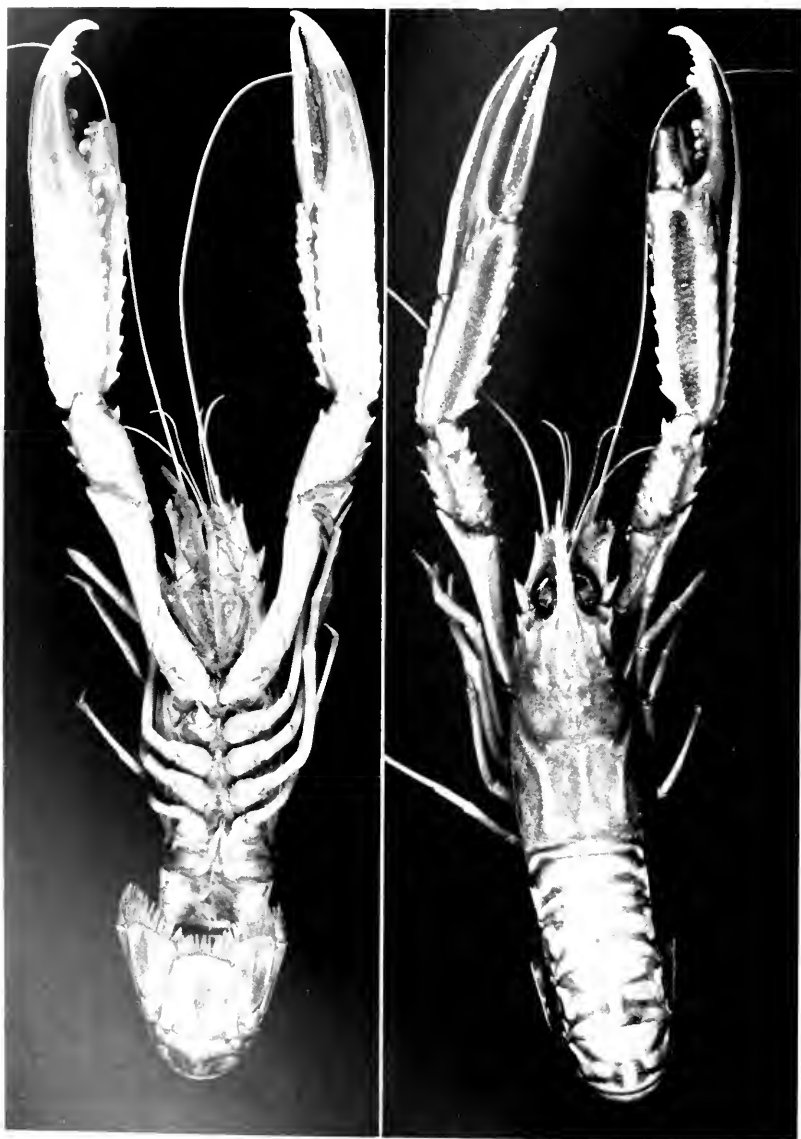
DISCUSSION: These specimens from Madeira are anatomically identical with material secured by the "Ara" in the Bay Biscayne, Florida, in 1923, differing only in their greater size. Since there seems to be no literature on eggs of this species, they are illustrated in plate 100. The "sponge" is quite large, would probably two-thirds fill a pint measure, the individual eggs being very small, of an average diameter of 0.5 millimeter, subspherical, attached to the setae of the pleopoda by a mucous secretion, forming closely crowded clusters.



Scyllarides acquinoctalis (Lund), female, greatly reduced, from Funchal, Madeira.



Scyllarides aquinoctalis (Lund), female, greatly reduced, with egg mass, from Funchal, Madeira.



Nephrops norvegicus (Linné), male, $\times 0.5$, from Almeria, Spain.

The writer has also examined a very large specimen, taken in the Galapagos Islands, by Dr. Charles Townsend, formerly director of the New York City Aquarium. This specimen is also anatomically identical with the several Atlantic specimens with which it was compared.

Full discussion of this ancient, primitive macruran has been presented in Volume III, Bulletin of the Vanderbilt Marine Museum, 1930, p. 80, plate 22.

Family: **NEPHROPSIDAE**

Genus: **NEPHROPS** Leach

Nephrops norvegicus (Linné)

✓

Plate 101

TYPE: Linné's type was collected in the "*Mari Norvegico*" and is deposited in the Museum Ludovicæ Ulricæ, Upsala.

DISTRIBUTION: The bathymetrical occurrence for this prawn ranges from 1 to 337 fathoms, the latter, a "Helga" station for it off Ireland, being next to the greatest recorded depth for it (Selbie, 1914), Senna's (1903) record of 416 to 450 fathoms, west of Sicily, being the maximum depth recorded.

Geographically it ranges from off the south coast of Iceland, where it occurs in such abundance that it is the principal food of the cod, as well as food for man, south (Hansen, Selbie). It is also abundant on the coasts of Scotland, excepting in the Hebrides, Shetlands and Faeroes, likewise abundant on the coasts of England and on the entire Irish coasts (Bell, Hansen, Selbie, and others). It is found on the entire coast of the Scandinavian Peninsula (Sars, Meinert, Hansen, and others); on the coast of Denmark (Hansen, Stephenson); on the Atlantic coasts of Belgium and France; also on the coast of the Hispanic Peninsula, the Mediterranean shores of Spain and France (Van Beneden, Bonnier, Caullery, Nobre, Boone); in the Mediterranean and Adriatic off Italy (Heller, Senna), and on the coast of Morocco (Milne Edwards).

MATERIAL EXAMINED: Three large males, taken at Almeria, Spain, Mediterranean Sea, April 7, 1929.

COLOUR: The general colour of the body is pale flesh with deeper tones of this marking the pattern and with light brown pubescence; eyes shining black.

TECHNICAL DESCRIPTION: This species, which is one of the most valued edible species of Ireland, Iceland and the Scandinavian countries, attains a total body length of 120 millimeters, of which the carapace and rostrum is 80 millimeters, the rostrum being 27 millimeters from apex to the orbital angle.

The carapace is produced anteriorly into a strong, acuminate rostrum, projecting, almost three-fifths as long as the carapace; seen dorsally the rostrum has a triangular form with the narrowed portion beyond the eye distinctly deflected and the apical portion beyond the subdistal lateral spines curved sharply upward. There is one inferior subdistal spine. There are four pairs of strong spines on the lateral margins of the rostrum, these spines being directed obliquely upward and outward, the proximal first and second pairs, situated respectively above and anterior to the cornea are usually weaker, the third and fourth pairs increasing in size; there is a median groove on the rostrum between these teeth, which also extends for a short distance back on the carapace, the lateral borders of this groove being thickened and also continued backward on the carapace, where they diverge and are replaced posteriorly by a linear series of four to six forward directed spinules. Between these two rows there is a median series of vestigial spines which extend variously half or all the way to the cervical margin. The cervical and hepatic grooves are very deep. The postcervical portion of the carapace has a strong median carina which bears a double series of several small spines, this carina being in line with the median row of the precervical region. A short distance behind the orbital margin and approximately opposite the posterior termination of the rostral carinae is a longitudinal series of three or four strong, sharp, forward-directed spines, the posterior of which is anterior to the gastric sulcus. In line with these, but on the postcervical region there is a strong spine immediately behind the cervical groove and behind this spine a strong ridge, which anteriorly curves forward and outward, confluent with the posterior border of the cervical groove. Posterior to the orbital margin and slightly above the blunt orbital angle, there is a single tooth, in line with the first spine of the series above this one,

on the frontal margin. Below this and anterior to it on the antennal angle there is a sharp spine and behind this and the hepatic sulcus is a weaker spine. On the postcervical region there is a very strong lower lateral carina, which arises just behind the cervical groove, this ridge curving posteriorly and extending to the deep groove which parallels the posterior margin. The lower lateral and posterior margins of the carapace form a continuous wide flat carina.

The abdominal somites are individually sculptured, a pattern of distinctive flat carinae alternating with ridges. The first somite has the anterior two-thirds smooth, convex, this area being bordered posteriorly by a wide deep groove which terminates laterally at the short flat longitudinal carina, which margins the proximal of the short triangulate epimera, there being also a small depression on the epimera, this bordered distally by flat carinae. The second somite is one and a third times as long as the first and is divided transversely into three elevated bands, separated by two transverse grooves, the anterior of which borders the posterior of the short, convex, anterior portion of the somite, this groove being continuous in the median region, laterally passing just behind the anterior marginal flat carina of the epimera which the groove transverses obliquely toward the posterior angle. The median elevated band of this somite is about twice as long as the anterior groove, this band forming a rounded lobe laterally, continuous with which there is a narrower, semicircular band on the proximal area of the epimera; the posterior arc of the band uniting with the posterior carina at the proximal angle of the epimera. The second, or posterior groove, is interrupted medially by a flat longitudinal carina, on either side of which the groove extends to the postlateral angle of the epimera; thence is deflected anteriorly within the arc of the curved median carina; below the postlateral angle there is a short, wide carina, directed obliquely toward the postlateral apex of the epimera; a V-shape carina ornaments the median distal region of the epimera. This epimera is about as wide as the somite with the anterolateral angle rounded, the margins flat carinae, the postlateral angle an acuminate tooth. The third, fourth, fifth and sixth somites are of nearly the same length medially, the respective epimera successively decreasing in size posteriorly and the pattern formed by the grooves and carinae, repeating the same general design, but varied in the

proportions of the carinae, especially the median longitudinal flat carinae increasing in width and prominence on each successive somite posteriorly, as do also the transverse median elevated areas on either side; these on the pretelsonic somite forming three approximate triangles, posteriorly directed, the lateral pair being separated from the median one by a pair of triangulate depressions with apices directed anteriorly. The epimera of the third somite are more triangulate than those of the second with the anterolateral margin convex, crenulate or spinose, the postlateral margin sinuate, distally concave, the two margins converging to form a distal tooth with the apex directed posteriorly. The fourth epimera are similar to the third pair but a little smaller, with a more acute distal tooth; the fifth pair are similarly smaller than the fourth, while the epimeral area of the sixth somite is different, being excavate on both anterior and posterior margins, forming a median triangular process which is distally rounded. The telson is subequal in length to or about a millimeter longer than the sixth somite but distinctly narrower. The telson is about one-fifth longer than its proximal width; the distal width is about one-third less than the proximal, the lateral margins being flat, carina-like, terminating in a small, subdistal tooth; the distal margin is evenly rounded between these teeth and fringed with setae. The proximal area of the telson is elevated in a wide, short, triangle medially and posterior to this on either side is a very narrowed, elongated triangle, separated on the outer side by a groove from the marginal carinae and with the apex of this wedge-like triangle confluent with the lateral carina at the base of the subdistal marginal tooth. The uropoda are strong, with a short peduncle terminating in a small spine at each the inner and outer distal angle. Both blades are wider distally, the inner one being as long as the telson and as wide distally with this margin truncate with the lateral angles rounded and setigerous; a single, oblique, nearly median longitudinal carina; the outer blade exceeds the length of the inner one by the articulated distal joint which has its setose distal margin more convex; there is also a strong, subdistal tooth on the lateral margin of the proximal article; there is a strong longitudinal midrib and a second, incomplete, longitudinal midrib between the median rib and outer lateral margin.

The eyes are large, shining black, subspherical.

The inner antennae have the basal articles beneath the eye, shielding its inner inferior side, the distal peduncular article terminating about beneath the subdistal pair of rostral spines; the two-branched flagella extend to the base of the propodus, the outer branch being about one-third thicker than the inner one and slightly longer.

The outer antennae have a five-jointed peduncle, the first article being ventral, with a short, acuminate, median distal spine, also with the aperture of the green gland; the second article is the first one dorsally visible and is produced into a strong, out-jutting sharp tooth at the outer distal angle; this supports the short, lanceolate scaphocerite, which extends only as far forward as the subdistal pair of rostral spines. The inner and distal margins of the scaphocerite are convex, furnished with long plumose setae, the greatest width of the scaphocerite being midway the length of the blade, tapering in both directions; the outer lateral margin slightly concave, the outer distal angle a sharp tooth; the third, fourth and fifth antennal peduncular articles are successively smaller, located beneath the scaphocerite; the flagellum is multi-articulate, the annuli thickened proximally, tapered distally, this flagellum extending beyond the cheliped from one to one and a half inches.

The first pair of chelipeds are greatly enlarged, being equal to the total length of the body and subequal to each other; the merus triquetral, very slender proximally but thickened distally with a sharp tooth at the upper distal angle and a very much stronger projecting tooth at the outer angle; the carpus is three-fifths as long as the merus but much wider and thicker, armed with five longitudinal series of spines, one row each on the inner and outer lower lateral margins and three rows, a median and two submedian rows, on the upper surface, the spines being of irregular size, but coarse, compressed laterally to a ridge and very sharp distally. The propodus and finger together are as long as the carapace plus the first two abdominal somites; these joints are swung obliquely so that the fingers open nearly horizontally, the lower margin of the fixed finger and palm forms the outer lateral margin, and the upper margin of the palm and hinged finger forms the elevated inner lateral margin. The propodus is nearly four-sided in cross-section, due to the fact that

both lateral margins are produced to a strong keel and there is also a strong median longitudinal keel extending from the median proximal area to the base of the fixed finger; the lower inner and outer ridges are thicker than the upper one; the first three each bear a double longitudinal series of coarse, acuminate, forward-directed spines, while the upper median ridge usually bears only a single series of these spines. The areas of the palm between these ridges form wide channels, the two on the upper face being clothed on with a fine short pilosity, this also being continued on the proximal three-fifths of the hinged finger and on seven-eighths of the fixed finger. The fingers are about four-fifths as long as the palm, the fixed finger being much the thicker, having the outer margin convex distally, the apex incurved, acuminate, projecting slightly beyond that of the hinged finger. The cutting edges of the two figures are furnished with numerous large molars, of unequal sizes, interspersed with small teeth, as shown in plate 101.

REFERENCES: *Cancer norvegicus*, LINNE, C. VON, Syst. Nat. ed. XII, 1766, p. 1058.

Astacus norvegicus, PENNANT, T., British Zool., 1777, vol. IV, p. 23, pl. 13, fig. 1.

Nephrops norvegicus, LEACH, T., Edinb. Encycl. 18, vol. VII, p. 400.—BELL, T., Hist. Brit. Stalk-eyed Crust., 1853, p. 251, figure, also early synonymy.—STEPHENSON, K., Kjobenhavn Naturh. Foren. Vednsk. Meddel. 1907-09, p. 279, numerous Scandinavian references).—SELBIE, C. M., Fish. Ireland, Sci. Invest. 1914, pt. I, Decapoda Reptantia, p. 47 (references).—NOBRE, A., Crust. Decapode Stomat. Marinhos de Portugal, Inst. de Zool. da Univ. do Porto, 1931, p. 242, fig. 136 (with Portuguese distribution and most extensive synonymy).

Family: **PENAEIDAE**

Genus: **PENEUS** Fabricius

Peneus merguiensis de Man

Volume VI, plate 24

MATERIAL EXAMINED: Two specimens, taken in 25 fathoms, seven miles northeast of Corregidor Island, Manila Bay, Philippine Islands, June 12, 1929, by the "Ara" World Cruise.



Palaemon caementarius Molina, s.s Poepig, female and male, nearly natural size, from Callao, Peru.

DISCUSSION: This unusually beautiful, edible prawn is again reported in the Vanderbilt Collection, this time from the Philippines, apparently establishing the second Philippine record for it, the first having been reported by Mr. Bate from the "Challenger" collections (1886). The present specimens, an adult male, measuring 8.75 inches from apex of rostrum to apex of telson, and a female, measuring 7.13 inches, in the same line, were secured by the "Ara" World Cruise and contribute the first record of the colour of the living prawn, which Mr. Vanderbilt described in his field notes as follows: "Colour of body brownish-pink along the segments, legs coral-red, eyes blue-green." It was captured by the "Alva" World Cruise at Noumea, New Caledonia, and is fully described and figured in Volume VI, Bulletin of the Vanderbilt Marine Museum, 1935, p. 96, pl. 24, text figure 7.

Family: PALAEMONIDAE

Genus: PALAEMON Fabricius

Palaemon caementarius Molina, s. s. Poeppig

✓

Plate 102

NAME: *caementarius*: a mason.

TYPE: This species, first published anonymously in 1776, by the Abbe Don Juan Ignacio Molina, and republished under his own name in 1782, was based upon his natural history collections made in Chile, while resident there, and left in Chile when he, like others of the Jesuit order, was expelled. His manuscripts relating to this collection were recovered and sent to him in Italy; they are deposited in Bologna, Italy.

Herr Poeppig (1836) redescribed the species in greater detail, from specimens obtained from the freshwater streams of Aconcagua, Chile, in the "Mus. Zool. Lips. ac Soc. Nat. Curios, etc."

Dr. Henri Milne Edwards (1837) described the same species as *Palaemon gaudichaudi*, from material collected in Chile by M. Gaudichaud and deposited in the Paris Museum. In 1843 Dr. Milne Edwards and M. Lucas published an excellent colour figure of this species, made by M. Valliant, showing the shrimp to be

an evenly coloured light olivaceous green. The illustration is apparently based on a female.

DISTRIBUTION: In addition to the above cited Chilean localities for the three sets of type material recorded, a series of specimens of this species were obtained by Dr. R. E. Coker, of the United States Bureau of Fisheries, in Peru at Pacasmayo, Lima market, in the Rimac below Lima, at Arequipo and Mollendo. These specimens were deposited in the United States National Museum. In her report on these, Miss M. J. Rathbun (1910) also gives Ecuador in her distribution of the species, but fails to list either specimens, or any authority for this more northern locality.

The reliably known distribution of *Palaemon caementarius* is from northern Peru to southern Chile, where it is found rather abundantly along the banks of freshwater rivers and their tributaries, including irrigation ditches.

MATERIAL EXAMINED: Eight specimens, four females, two of which are ovigerous, and four males, collected in Callao, Peru, 1935, by the "Alva."

HABITAT: This was described by the Abbe Don Molina, in 1782, as follows:

"Of the freshwater crabs, the most remarkable is that called the *mason* (*Cancer cementarius*). It is about eight inches long, of a brown colour striped with red; the flesh is very white and preferable to that of any other species of river or sea crab. They are found in abundance in almost all the rivers and brooks, on whose shores they build themselves, with clay, a small cylindrical tenement, which rises six inches above the surface of the ground, but admits the water, by means of a subterranean canal extending to the bed of the river. They are readily caught by letting down a basket or osier pot, with a piece of meat in it, into the water." (From the English edition, History of Chile, 1809, vol. I, p. 171, London).

TECHNICAL DESCRIPTION: This species, considered a great delicacy by both white and Indian residents of western South America, is a close congener of the later-described *Palaemon olfersi* (Wiegmann) 1836, from the coasts of Brazil.⁴

The present species is characterized by a short, thick cara-

⁴*Palaemon olfersi* Wiegmann, Archiv. f. Naturg., 1836, Bd. II, pt. I, p. 150.

pace and moderately stout abdomen, as shown in plate 102. The rostrum is extremely short, arising a very short distance behind the orbital margin and extending only as far forward as does the basal antennal article. Viewed dorsally, the rostrum is triangulate with a median crest, beset with eight teeth; seen in profile, this crest originates as a low carina on the carapace, not more than two millimeters behind the frontal margin and has its upper border convex, narrowing anteriorly to an acuminate apex; the superior margin is beset with eight short, sharp, serrate spines, the proximal of which is above the carapace, the second, third and fourth spines above the orbit, the remaining four, which are also of successively diminishing size, are spaced along the deflected distal portion of the rostrum. The interspaces between these dorsal teeth are setose. There are two weak spines on the short, upcurved, subdistal portion of the inferior rostral margin.

The rostral formulae of the present series of Peruvian specimens is as follows:

Females $\frac{7}{2}$, $\frac{7}{2}$, $\frac{8}{2}$, $\frac{8}{3}$. Males: largest $\frac{7}{2}$, next $\frac{7}{2}$, third $\frac{8}{2}$, smallest $\frac{8}{2}$. There is a distinct short, stout, acuminate post-orbital spine present, otherwise the carapace is glaucous, as is also the abdomen, except the telson. The latter is shorter than the uropoda, triangulate, tapered to a narrowed, blunted apex and bears dorsally two pairs of articulated spines, placed sub-median and sub-distal.

The first and second basal articles of the inner antennae each bear a small, produced tooth at the outer distal angle; the flagella consist of three slender, multi-articulate, unequal branches, the longest of which extends not quite to the tip of the dactyl of the lesser great cheliped of the male.

The outer antennae have the pedunculate article with a spine at the outer distal angle; the scaphocerite with a subdistal spine at the lateral margin, the distal margin convex, these two articles, considered together, being one-half as long as the carapace; the flagellum is two-branched, the longer branch extending to midway the dactyl of the greater cheliped of the male.

The eye is not very large, subspherical, extending only two-thirds of the length of the very short rostrum, the visual range is chiefly lateroventrad. The stalk is expanded dorsally; the cornea is black, convex, composed of quite small facets.

The first pair of legs are small, chelate, typical of members of this genus.

The second pair of legs of the male are strikingly unequal, the left one normally being greatly the larger, as shown in plate 102. In the female these legs are much weaker, being only slightly unequal, as shown in plate 102. The male left (larger) cheliped has the ischium weak looking, but extending as far forward as the rounded anterolateral angle of the body; the merus, carpus and especially the propodus are successively increasingly dilated; the merus being one and three-fifths times as long as the carpus, evenly convex on the upper surface, less so ventrally, with both inferior lateral margins increasingly spinose distally; a short, oblique subdistal sulcus indents the inner surface of the merus. The carpus is three-fourths as long as the merus, with the proximal end about the same width as the distal margin of the merus, the carpus being abruptly dilated, with all surfaces, especially the ventral, convex; the dorsal surface, also convex, is marked by an oblique longitudinal depression which extends to the anterior margin and is also confluent with the stronger transverse subdistal groove; the propodus is greatly dilated, the palm alone being as long or longer than is the carapace from orbital angle to posterior margin; the palm is swung so that the fingers open horizontally, the broad sides of the palm being dorso-ventral, the normal upper margin forming the outer lateral margin, as does the hinged finger, while the usual ventral margin of the palm and fixed finger form the inner lateral margin. The two lateral margins of the palm are subparallel, the wide upper surface being evenly convex transversely, the ventral surface similar, but less so; there is a depression in the palm anteriorly, behind the base of the hinged finger and extending obliquely posteriorly from this pit is a much less, distinct yet definite groove, curving backward and outward to the posterior margin of the palm. On the ventral surface of the palm there is a definite transverse sulcus anteriorly, behind the bases of the fingers, also, arising behind the base of hinged finger there is a longitudinal sulcus which curves inward posteriorly on the palm toward the basal angle. The fingers are three-fourths as long as the palm, the attached finger being diagonally deflected inward, with the distal contour rounded to the acuminate, dentate apex. The hinged finger is

subequal in length to the fixed finger, slightly slenderer proximally and with the outer margin curved, the apices meeting; an elliptical hiatus exists between the fingers, each of which bears on the cutting edge six teeth, the proximal of which is a low molar, followed by four longer, closely spaced, cylindrical, bluntly rounded distally teeth, and more widely spaced, a fifth similar tooth; the apices of the fingers are curved, acuminate teeth, that of the lower finger overlapping that of the upper one. Numerous tufts of stiff bristles occur between the teeth. The entire surface of the great cheliped is continuously beset with coarse, rough, brown spines, those on the ischium and proximal merus being weak, these murications consistently increasing in size distad on each joint, also in size distad on the successive articles, the smaller spines of the propodus being as large as the larger ones of the more proximal joints. On the distad half of the palm, also on the fingers, these spines become quite large. Some on the ventral-distal palm have their inferior surface grooved, file-like.

The smaller male cheliped, when extended, reaches only to the proximal end of the palm of the opposed great cheliped, the contour of the respective joints being similar; the propodus has the fingers about one-sixth to one-fifth longer than the palm, which is short, not quite 1.5 times the length of the carpus and only moderately inflated; the fingers are long, slender, subequal, with broad, rounded spoon-tips, the two cutting edges are each set with shallow, insignificant denticles, but are furnished along either side of their cutting edges with a double longitudinal series of tufts of coarse bristles, these being more numerous, sieve-like, on the upper side. Like the large, opposed cheliped, the surface of the smaller great cheliped is entirely covered with spinose murications, similarly arranged, those of the smaller cheliped being correspondingly smaller.

The female second pair of chelipeds are occasionally almost equal, more frequently one is about ten per centum longer than the other, distally weaker than the smaller great cheliped of the male, but of similar structure. The female has the palm no longer than the related carpus, the fingers being about 1.3 times as long as the palm, slender, meeting throughout their entire length, augmented with numerous tufts of bristles, apices spoon-shaped.

The ambulatory legs of both sexes are similar, successively decreasing in length from the third to fifth pairs, slender, moderately compressed laterally, muricate, weakly so on the merus, the size and number of spines increasing on the carpus, propodus and dactyl; the inferior margin of the propodus is also armed with a double longitudinal series of long, sharp spines and intermediate tufts of bristles; the dactyl is slender, very curved, slightly more than one-half as long as the related propodus, with the distal third forming a very sharp curved tooth.

One of the male specimens measures about 165 millimeters total length, of which 95 millimeters represents the body length and 70 millimeters, the extended portion of the great cheliped, the total length of this great cheliped being 105 millimeters. A female specimen has a total length of 120 millimeters, 98 millimeters of which represents the body length and 22 millimeters, the extended portion of the great cheliped, the total length of this great cheliped being 55 millimeters.

The ova are very small, of about 0.4 millimeters long diameter; the "sponge" or egg-mass carried by a single female containing an estimated five thousand or more ova.

- REFERENCES: *Cancer cementarius*, MOLINA, J. I., Sulla Storia naturale del Chili, 1782, p. 207; publ. anonymously, 1776.
- Palaemon caementarius*, POEPPIG, E., in Wiegmann's, A. F. A., Archiv. f. Naturg. Berlin, 1836, Bd. II, pt. I, p. 143.
- Bithynis caementarius*, RATHBUN, M. J., Proc. U. S. Nat. Mus., 1910, vol. XXXVIII, p. 604.
- Palaemon gaudichaudii*, MILNE EDWARDS, H., Hist. Nat. Crust., 1837, t. II, p. 400.—MILNE EDWARDS, H. et LUCAS, H., in d'Orbigny's, A., Voy. Amérique Meridionale, Paris, 1844, t. VI, pt. I, p. 37, atlas, t. IX, pl. 17, fig. 2, color.
- Bithynis caementarius gaudichaudii*, RATHBUN, M. J., *op. cit.*, p. 560, pl. 54, fig. 1.

Family: **PAGURIDAE**

Subfamily: **Pagurinae**

Genus: **PETROCHIRUS** Stimpson

Petrochirus bahamensis (Herbst)

in shell of

Cymatium gibbosum Broderip

✓

Volume II, plate 1

MATERIAL EXAMINED: One very large specimen, in the mollusk shell, *Cymatium gibbosum* Broderip, dredged in 45 fathoms, five miles west of Isla del Rey, Isla de Morete, Perlas Islands, bearing 270° true, 4.5 miles distant, in Panama Bay, Pacific Ocean, March 2, 1938, by the "Alva" American Pacific Cruise, 1938.

DISCUSSION: The present specimen, which is an exceptionally large example of the species, is identical in diagnostic characters with those from the West Indies, reported by the writer (1930).

REFERENCES: *Petrochirus bahamensis*, BOONE, L., Bull. Vanderbilt Mar. Mus., 1930, vol. III, p. 21, pl. 1 (with full description and figure).

Genus: **CALCINUS** Dana

Calcinus elegans (H. M. Edwards)

✓

Volume VI, plate 3

MATERIAL EXAMINED: Twenty-four specimens, taken on Kusai Island, Caroline Islands, January 2, 1929, by the "Ara," establishing the first record of it in the Carolines.

DISCUSSION: The "Ara" World Cruise secured an exceptionally fine series of this gaily coloured small hermit crab, which includes specimens ranging in size from the earliest post-larval crabblings to unusually large old specimens with the precervical portion of the carapace nearly an inch long.

This species was secured by the "Alva" World Cruise, 1931-1932, at both the Society and Fiji Archipelagoes, and is fully described and illustrated in Volume VI, Bulletin of the Vanderbilt Marine Museum, p. 23, pl. 3.

Genus: PAGURUS Fabricius

Pagurus cataphractus, new species

✓

Plate 103

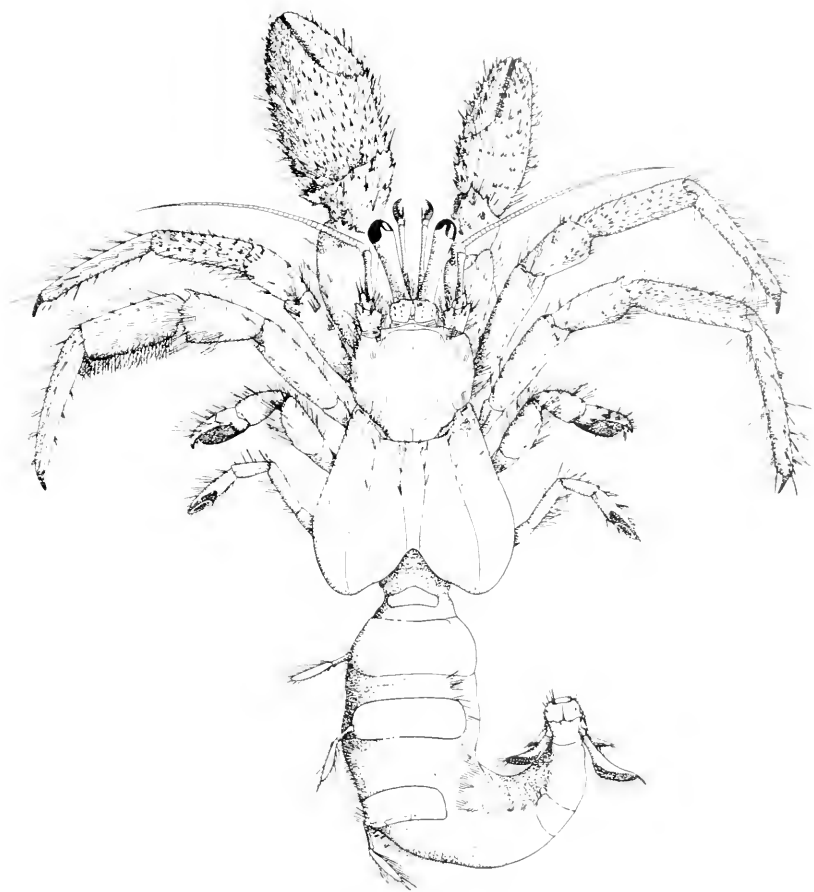
TYPE: This was collected by the yacht "Ara" at Lahaina, Maui Island, Hawaiian Islands, December 12, 1928, and is deposited in the Vanderbilt Marine Museum.

DISTRIBUTION: Littoral zone of the Hawaiian Archipelago.

TECHNICAL DESCRIPTION: This species, which closely resembles the older species, *Pagurus setifer* H. Milne Edwards, 1836, known from many records in that great area extending from the east coast of Africa to Japan, i. e., from about Long. 40° E. to Long. 130° E. and from about Lat. 30° N. to Lat. 12° S., is distinctly separated therefrom by several definite characters.

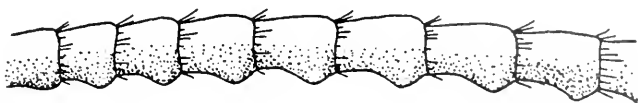
The carapace of *Pagurus cataphractus* Boone has the calcified precervical portion about seven-eighths as wide anteriorly as its median length; the setigerous lateral margins are so little divergent posteriorly that they appear nearly parallel; the posterior margin is defined by the usual cervical curvature, the dorsal surface being quite flattish; the softer postcervical region is about as long in the median line as the precervical, but has the postlateral margins widely convex. The asymmetrical abdomen has four wide, transverse calluses dorsally, well separated from each other by wrinkled spaces covered by soft tough membranes, each callus giving rise on the left margin to a uniramous pleopod, consisting of a peduncle one-half as long as the related elongate, narrowly oval, setigerous, distal blade, which is not quite one-half so long as the width of the related callus. The asymmetrical rhipidura is larger on the left side; the transversely articulated telson is rectangular, the proximal portion being slightly longer than the distal, and the distal margin slightly convex.

The eyestalks are depressed cylindrical, moderately dilated distally and about four-fifths as long as the anterior margin of the carapace; they exceed the length of the antennular peduncle by slightly more than the length of the cornea and similarly are longer than the antennal peduncle. The cornea, which are terminal on the dilated stalks, fully occupy the distal fourth thereof, being dorsally of less depth than ventrad.

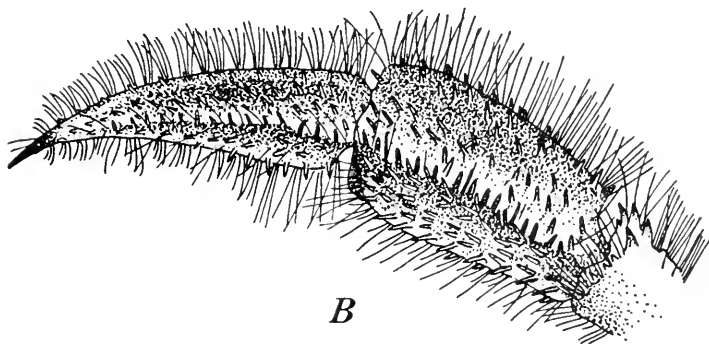


Pagurus cataphractus Boone, type, $\times 0.8$, from Lahaina, Oahu, Hawaii.

The antennal acicule is narrowed, irregularly triangular, irregularly spinose on the inner lateral and distal margins, also beset with numerous tufts of setae along the margins. The apex is directed obliquely outward, extending above the predistal pedun-



A



B

Text figure 14.—*Pagurus cataphractus* Boone, type: A, section of antennae, showing the twenty-fourth to thirty-fifth articles; B, propodus and dactyl of leg, showing groove and spinose ornamentation.
Both greatly enlarged.

cular article for little more than half its length. The antennal flagellum has each of the articles comprising the distal three-fifths of the whip produced into a protruberant convex dilation at the inner distal angle. This peculiar formation of the flagella is a subtle mimicry of the fronds of one genus of Indo-Pacific hydroids.

The chelipeds are unequal, the left one greatly exceeding the right, in the ratio shown in plate 103; neither hand is inclined inward. The left cheliped averages a length of 1.5 times the total length of the carapace, only the merus, carpus and propodus

being dorsally visible beyond the body. The distal portion of the merus and carpus are dorsally spinose-setose; the propodus is as long in the median line as the combined length of all the preceding articles and is oval in contour, dorsally very convex with a slight outer submarginal depression which also extends the length of the proximal finger; the fingers meet throughout their length, the black apices being rounded, spoon-like. The outer margins and surface are beset with strong, outward and somewhat obliquely directed, thorn-like, black-tipped spines, interspersed with stiff, coarse bristles, which most frequently but not always, arise in ones, twos, or threes, being much more abundant than those on *P. setifer*, but never forming wreaths around the base of the spines as in *setifer*, yet not obscuring the surface sculpture and spines, as occurs on *P. punctulatus* Oliver. The right cheliped is similar but smaller.

The ambulatory legs of the first and second pairs have the legs of the right side with the respective dactyli longer than those of the left side, the other right joints being only as long as those of the left legs. The second left ambulatory leg is very specialized, having the propodus and dactyl widened and ornamented uniquely. The propodite has this outer lateral surface 0.7 as wide as long, decisively longitudinally carinate, this spinose carina occurring about 0.4 of the width from the inferior or posterior margin, with the outer 0.6 of this surface distinctly more deeply concave. The inferior lateral margin and adjacent surface, including the carina, bears in close-set, transverse series approximately six spines per series, the first spine being marginal and the sixth accentuating the carina, while the more concave outer portion of this surface, between the carina and the superior margin bears about four smaller intermediate spines, per transverse series, in addition to the palisaded, outer, marginal row of stronger spines. Repetition of this transverse series occurs across the entire length of the article. The related dactyl, which is a little more than 1.5 times as long as the propodus, is decidedly curved, with the anterior margin convex, the posterior, concave, with the flattened, outer surface narrowed distally, both lateral margins and the longitudinal carina spinose as on the preceding article, with the concave surface between the inferior margin and carina shallowly concave and continuously beset with spines, about two in transverse series proximally and one spine

distally, while in the more concave portion between the carina and anterior margin there are also two spines in transverse series proximally and one, or none distally; these series being repeated throughout the length of the dactyl. These two articles of the second left ambulatory leg are *not* "very elegantly tessalated by a series of deep cut and extremely regular transverse grooves," as defined and illustrated for *P. setifer* by Dr. Alcock. In the present species about 0.9 of the spines have the whitish bases much enlarged; in the non-marginal spines this enlargement most frequently has the form of convex, circular dome-shaped base, from the center of which the thorn-like, procurved, distal portion arises. Some such dome-like large tubercles lacking the thorn-like distal portions occur on the interstices between the spines.

This species, *Pagurus cataphractus* Boone, belongs in the Indo-Pacific group of *Pagurus*, of which *P. setifer*,⁵ *P. Euopsis*⁶ and *P. fabimanus*⁷ are members, all having the inner distal angle of the articles of the distal half of the antennal flagella dilated and the propodite and dactyl of the second left ambulatory leg expanded and distinctively sculptured. The present species is very closely related to *setifer* H. Milne Edwards, from which it differs in the above cited specialization of the second left ambulatory; in the greater abundance and different arrangement of setae on the chelipeds and ambulatories, those of the present species never forming wreaths at the base of the spines as in *setifer*, in their abundance more resembling *P. euopsis* Dana from which the present species differs in the sculpture of the third left leg and other important characters. *Pagurus cataphractus* Boone differs from *P. fabimanus* in the greater spinosity of the chelipeds, the different sculpture of the second left ambulatory leg and the presence of spines on all the legs, which in *P. fabimanus* are scabrous only. The ratio of length between the eyestalk, antennular peduncle and antennal peduncle of the present species is also a character which differentiates it from each of the above-named species.

⁵*Pagurus setifer* Henri Milne Edwards, Ann. Sci. Nat. Zool., Paris, ser. 2, t. VI, 1836, p. 274. —Alcock, A., Calcutta Mus., Cat. Indian Decapod Crust., pt. II, Anomura, Fasc. I, Pagurides, 1905, p. 83, pl. 8, fig. 3.

⁶*Pagurus euopsis* Dana, J., Proc. Acad. Nat. Sci. Phila., 1852, p. 7; also in Wilkes, C., U. S. Explor. Exped. Crust. Vol. XIII, pt. I, 1852, p. 452, atlas XIII, pl. 28, fig. 6 a-c.

⁷*Pagurus fabimanus* Dana, J. D., Proc. Acad. Nat. Sci. Phila., 1852, p. 270; also *loc. cit.* 1852-b, p. 454, pl. 28, figs. 7 a-c.

Pagurus deformis H. Milne Edwards

✓

Volume VI, plate 5

MATERIAL EXAMINED: Four large specimens, in shells of *Turbo* species, collected in Zamboanga, Mindanao, Philippine Islands, January 16, 1929, by the "Ara" World Cruise.

DISCUSSION: The present series are exceptionally fine specimens and represent the third Philippine record for the species, previously reported from the Philippines by Adam White (1848), also by Mr. E. J. Miers (1875) in his report on the voyage of H. M. S. "Erebus" and "Terror" Crustacea, all of which material is deposited in the collections of the British Museum of Natural History, hence the "Ara" specimens become the first from the Philippines in an American museum. This species was also taken by the "Alva" World Cruise, 1931-1932, in Southport, Australia, and the Society Islands, and is fully described and figured in Volume VI, Bulletin of the Vanderbilt Marine Museum, 1935, p. 28, plate 5.

Pagurus varipes Heller

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Plates 104 and 105

TYPE: This was collected in the Red Sea by Herr Ritter v. Fraunfeld, in 1855, and is deposited in the Zoological cabinet of the University Museum of Vienna. (Heller *dixit*).

DISTRIBUTION: This species has been dependably recorded from the Red Sea southward on the east African coast at Mozambique, and eastward in the Persian Gulf, Southern India, Ceylon, and the Malay Archipelago. The Hawaiian specimens here recorded from the "Ara" World Cruise, thus substantially extend the known range of the species to the central Pacific.

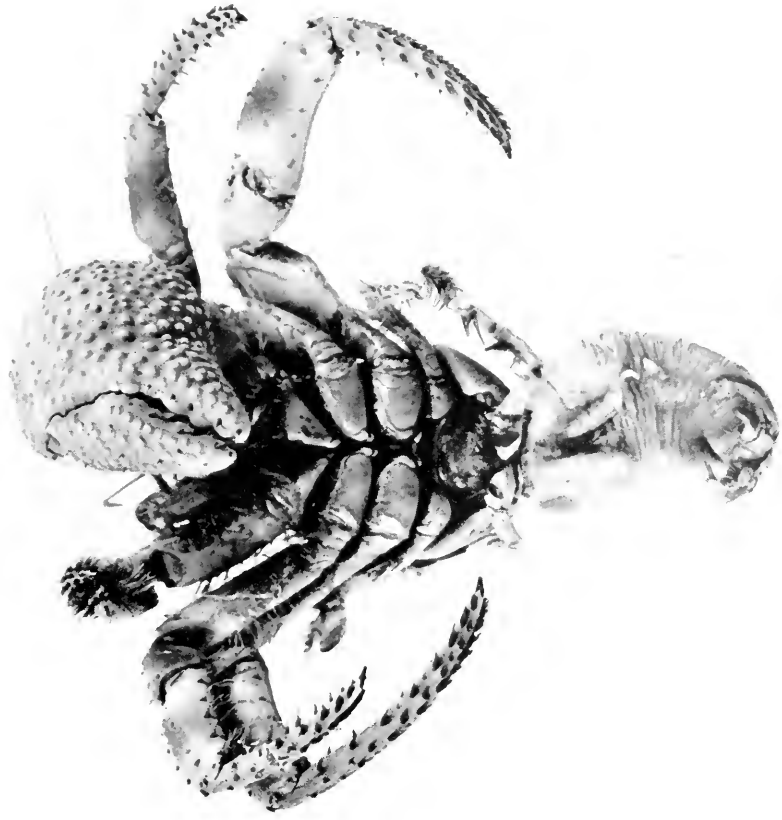
MATERIAL EXAMINED: Two large specimens, in shell of *Dolium* species, collected at Lahaina, Maui, Hawaii, December 12, 1928, by the "Ara" World Cruise.

TECHNICAL DESCRIPTION: This hermit is distinguished from *P. deformis* only in the following essentials:

(a) The upper and outer surfaces of the propodus and dactyli are paved with several longitudinal rows of conic or rounded,



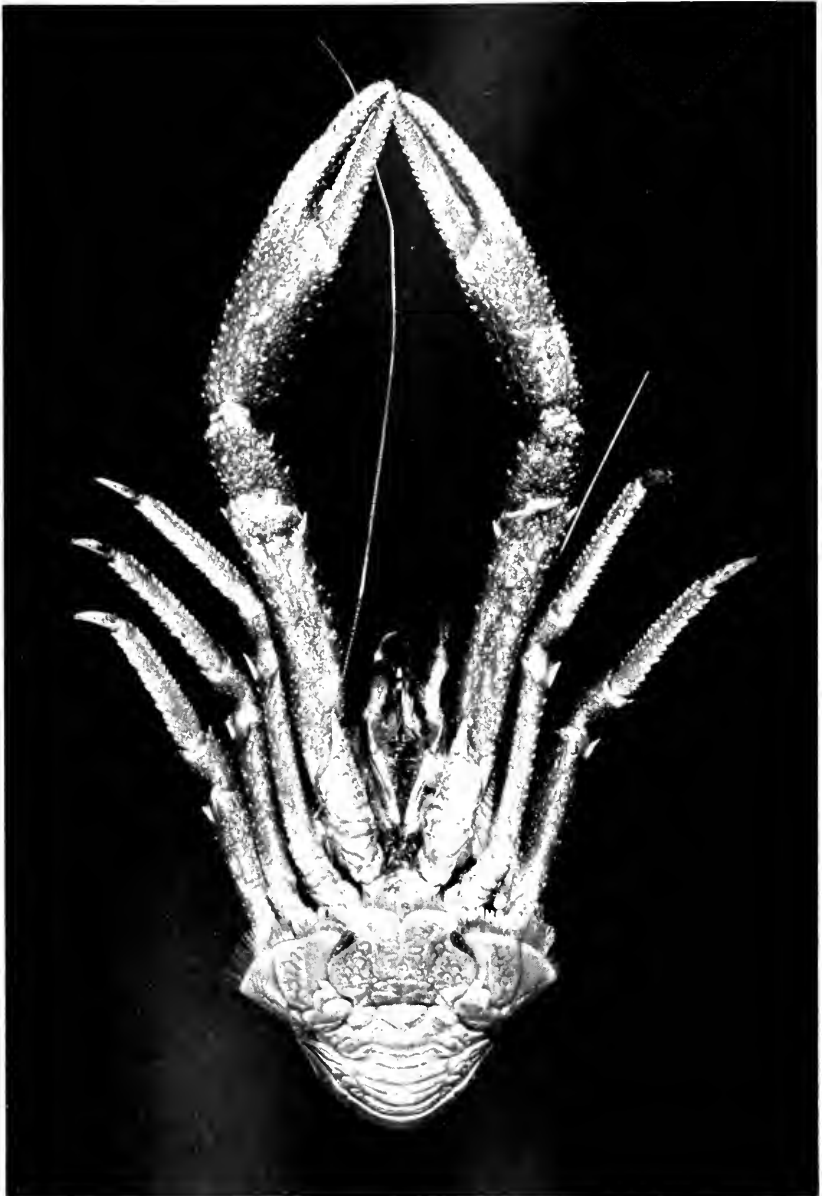
Pagurus variipes Heller, ♀ 1, found inhabiting shell of *Dolium* species,
Lahaina, Maui, Hawaii.



Pagurus caripes Heller, male, $\times 1$, from Lahaina, Maui, Hawaii.



Munida gregaria (Fabricius), $\times 1$, from Lengua de Vaca Point Light,
Ton Gay Peninsula, Chile.



Munida gregaria (Fabricius), $\times 1$, from Lengua de Vaca Point Light,
Ton Gray Peninsula, Chile.

polished granules, but there is no laminate erect crest or carina along the inner edge of the upper surface of the dactyl of the larger (left) cheliped.

(b) The third left leg has the outer surface of the dactyl longitudinally carinated near the lower margin.

(c) The male has no genital orifices corresponding with those of the female.

REFERENCES: *Pagurus varipes*, HELLER, C., Verh. Zool.-Bot. Ges. Wien, 1861, p. 22; Sitzb. Akad. Math.-Nat. Kl. Wien, 1861, Bd. XLIV, p. 244, pl. 1, fig. 1, and plate 2, figs. 2, 3.—KOSSMAN, R. A., Reise Roth Meer. Berlin Kgl. Preusse Akad. Wiss., 1877-80, Malacostraca, p. 75.—DE MAN, J. G., Notes of Leyden Mus., 1880, vol. II, p. 184; in Wiegmann, A. F. A., Arch. f. Naturg., 1887, t. I, p. 436.—CANO, G. Bull. Soc. Nat. Napoli, 1889, t. III, p. 265.—BOUVIER, E. L., Bull. Soc. Philom. Paris, 1891-1892, ser. 8, t. IV, p. 54.—HENDERSON, J. R., Trans. Linn. Soc. London, Zool., 1893, ser. 2, vol. V, p. 420.—ALCOCK, A., Cat. Indian Decap. Crust. Coll. Indian Mus., pt. II, Anomura Fasc. I, Pagurides, 1905, p. 90, pl 9, fig. 7.

? *Cancer pedunculatus* Herbst, J. F. W., Naturg. Krabben u. Krebse, Bd. III, heft IV, 1804, p. 25, pl. 61, fig. 2.

Pagurus pedunculatus, OLIVER, G. A., Encyl. Meth. Hist. Nat., 1811, t. VIII, p. 647.—OWEN, SIR R., in Beechey, Capt. F. W., Voy. H. M. S. "Blossom," Crustacea, p. 83.—HILGENDORF, F., Monastb. K. Preuss. Akad. Wissench. Berlin, 1878, p. 815.—ORTMANN, A., in Semon, R., Zool. Forschungsr. in Australian u. Malayischen Archip., 1894, vol. V, lief 1, p. 31.

Family: GALATHEIDAE

Genus: MUNIDA Leach

Munida gregaria (Fabricius)

✓

Plates 106 and 107

MATERIAL EXAMINED: Fifty-three specimens, dredged in 90 fathoms, five miles from Lengua de Vaca Point Light, Ton Gay Peninsula, Chile, January or February, 1935, by the "Alva."

Seven exceptionally large specimens, from the above-cited locality. Fifty-two specimens, mostly very large specimens, from the identical locality. Twenty-four specimens, of medium and small size, dredged in 9 fathoms, at Port Lagunas, Chile, February 13, 1935. Five specimens, of medium and small size, dredged in Chiquiso Channel, between Chiloe and Cailin Islands, Chiloe Archipelago, Chile, in 7 fathoms.

DISCUSSION: Although this species was previously taken by the "Ara," in 100 fathoms, Punta Arenas, Costa Rica, and described in Volume III, Bulletin of the Vanderbilt Marine Museum, p. 53, plate 12, the present Chilean series is of such exceptional value, both in extent and source, that it is desirable to present the following notes. The description is based on an average large specimen taken in the Ton Gay Peninsula dredgings, supplemented, at the conclusion, by a comparative analysis of a series of sixty-three specimens, showing the percentage of variation existent, especially in the number and arrangement of spines ornamenting the carapace and abdominal somites.

TECHNICAL DESCRIPTION: Carapace subrectangular, produced anteriorly to a slender acuminate rostral spine, which is subequal in length to the precervical portion of the carapace and is very compressed laterally, with the lateral margin finely carinate and the dorsal margin crested and denticulate, this crest originating as a non-denticulate carina extending briefly on the carapace, continuing forward on the rostrum, bearing six or seven compressed, forward and upward-directed teeth which normally increase in size from proximal to subdistal, this tooth being situated about two-thirds of the length of the rostrum, at the apex of the crest, beyond which the dorsal margin of the rostrum is concavely deflected to the apex. The inferior rostral margin usually, but not always, bears one strong obliquely downward and forward directed tooth, approximately opposite or slightly in advance of the large subdistal tooth of the dorsal series, this inferior spine being slightly in advance of the eye. There are a pair of short acuminate preorbital spines, one on either side adjacent to the base of the rostrum, another pair of subequal or sometimes slightly shorter spines occur, one each above the base of the antennae. The precervical portion of the carapace bears anteriorly about five unbroken transverse carinae and immedi-

ately posterior to these four similar carinae but which are interrupted by the deep cervical groove. On the postcervical region (counted in the median line) there are normally twelve transverse carinae, slightly interrupted by the cardio-intestinal grooves in the center and separated from the sides, by the lateral line, from similar carinae which are a continuation of the dorsal carinae. Each of these carinae is a finely beaded line, margined anteriorly by short, fine silky cilia. The first of the precervical carinae bear the above-described preorbital and antennal spines. The second carina bears in line with the preorbital a submedian pair of spines, and on either side of these variously 2, 3, or 4 spinules, which on young specimens are very small, sometimes obsolete. The third carina bears a submedian pair of spinules, sometimes with also a median spinule and usually another pair of spinules, one each just above the hepatic sulcus. There are also about four, sometimes five, spinules, along the anterolateral margin of the precervical carapace and another spine on the first postcervical carina near the margin. There is nearly always a single spinule, larger than the average, situated in the median lateral area, above and slightly posterior to the cervical groove. There are also usually six, sometimes only four, spinules, three each submedian along the inner portion of the first postcervical carina and a single submarginal spinule. There normally are no more spines or spinules on the dorsad of the carapace, but the first postmarginal carina of the sidewall is continuously spinulose with ten to twelve spinules; posterior to the last of these and just below the sulcus there are three or four spinules, one each on the third, fourth and fifth carinae, while above these yet on the sidewall are about six larger spines, the first of which is just below the lateral line and in continuation of the marginal spines of the dorsad series of the carapace; then there are four lateral spines occurring one each on alternate carinae, the fourth spine being in line with the second postcervical carina; behind this fourth spine and more dorsad are two more spinules, each on alternate carinae, the sixth one being subdorsad, almost in line with the first spinule of this series.

The anterior margins of the first, second and third abdominal somites are each spinulose, there being four spines each on the anterior margin of the first or most anterior carina of each

somite. On the very large specimens there are usually only two spines here on the first somite, these forming a well-separated, submedian pair, there being two pairs each on the anterior margin of the first carinae of the second and third somites, the outer pair of spines of each being approximately in line with the pair of the first somite and the inner pair submedian, between these.

The first abdominal somite has a flat carina posteriorly ciliate on the anterior margin which fits beneath the carapace and is followed in the median area by a smooth, glossy area which bears a single, submedian, transverse row of ten to twelve low granules, each of which is fringed with posterior-directed fine cilia; the posterior half of this somite is marked by four close-spaced, elevated, transverse, flat carinae, each being fringed on the anterior margin by fine cilia; the first carina bearing also on the anterior margin a well-separated submedian pair of forward-directed spines; these carinae are slightly interrupted and curved on the lateral portions, conforming to the contour of the epimeral region. The epimera are narrowed to a subacute rounded carinate margin and have the anterior margin bent upward, rimlike.

The second somite is about as long in the median line as the first, but with the epimera narrowed to an acuminate, triangulate tooth; this somite is similarly smooth anteriorly and transversely carinate on the posterior, but bears four submedian spinules on the anterior margin of the first carina, the outer pair being approximately in line with those of the first somite; the inner pair being subequally spaced between the outer pair.

The third somite forms the hinder margin of the dorsal portion of the abdomen and is about as long as the second, but with the smooth anterior portion smaller and the elevated transversely carinate portion longer; the first of the four carinae bear anteriorly four spinules in line with those of the preceding somite. The epimera are narrowed to an acuminate triangle.

The fourth somite is as long medially as the third, deflected, with the entire surface paved by four transverse flat carinae, each posteriorly finely ciliate; these carinae being interrupted and forming an elegant design on the epimera which are triangulate but less narrowed than those of the preceding somite.

The fifth somite is a trifle longer than the fourth one, with the epimera reduced, subacuminate; the posterior margin truncate above the base of the telson and concave on either side above

the uropoda, the entire surface being elegantly sculptured by flat, transverse, posteriorly ciliated carinae, which are interrupted and curved, following the contour of the somite. This pattern is continued on the uropod peduncle and proximal portion of the telson, their distal portions being paved with smaller, curved, posteriorly convex and ciliated squamae. The telson is one and a third times as long as the pretelsonic somite, with the distal margin widely rounded, fringed with long, silky setae. The two lateral lines that cut the telson are oblique. The uropod peduncle has a small spine at the inner distal angle; the blades are truncate distally, with the inner distal angle widely rounded, the usually exposed outer dorsad portions of each blade paved with squamae as on the telson.

The chelipeds are equal, 130 millimeters long on specimens having the carapace plus the rostrum 55 millimeters long. These chelipeds have the merus 50 millimeters long on the outer margin, triquetral, with the upper-inner margin serrate with coarse spines, a second submedian series of smaller spines on the upper surface, the three upper distal angles spinose; the carpus is 16 millimeters long, similarly triquetral and spinose on the inner-upper marginal and distal angle; the propodus and dactyl are 62 millimeters long, the palm being 34 millimeters long and 12 millimeters wide, distally, and the fingers 28 millimeters long. The palm is moderately dilated distally and bears a submedian longitudinal carina composed of erect, spinose squamae; both lateral margins of the palm and dactyli are similarly margined. The upper and outer surfaces of the merus, carpus, propodus and dactyli are almost continuously paved with these distally acute or spinose squamae, semiconcealed beneath a dense pilosity on the merus, carpus and propodus which is nearly absent on the dactyli, except along the bases of the cutting edges, the dactylar surfaces being continuously paved with these asperities which are subequal in size or a little larger than the teeth along the cutting edge. The apices of the dactyli are each incurved acuminate teeth.

The first, second and third pairs of ambulatories are similar and decrease in length in the order named, the first pair having the dactyli reaching to the base of the propodi of the chelipeds and the second and third pairs each decreasing in length by about the length of their respective dactyli. Each ambulatory has the

inner lateral and distal margins of the merus and carpus spinose; the propodi, which are about twice the length of the related carpal joints, are spinose along the upper lateral margin with the entire surfaces paved with these sharp squamae as are also the surfaces of the merus and carpus which are more thickly pilose than are the propodi. The dactyli are one-half as long as the related propodi, curved, laterally compressed, acuminate, with a dual series of long, brown setae along the upper margin.

The antennal flagella are about as long as the propodi.

The large eyes are reniform, set on short stalks and protected beneath by the several strong spines arising from the bases of both the antennae and antennulae.

The external maxillipeds have the second or subdistal article of the palp produced on the outer lateral margin into a moderately convex process which bears distally a long tuft of setae.

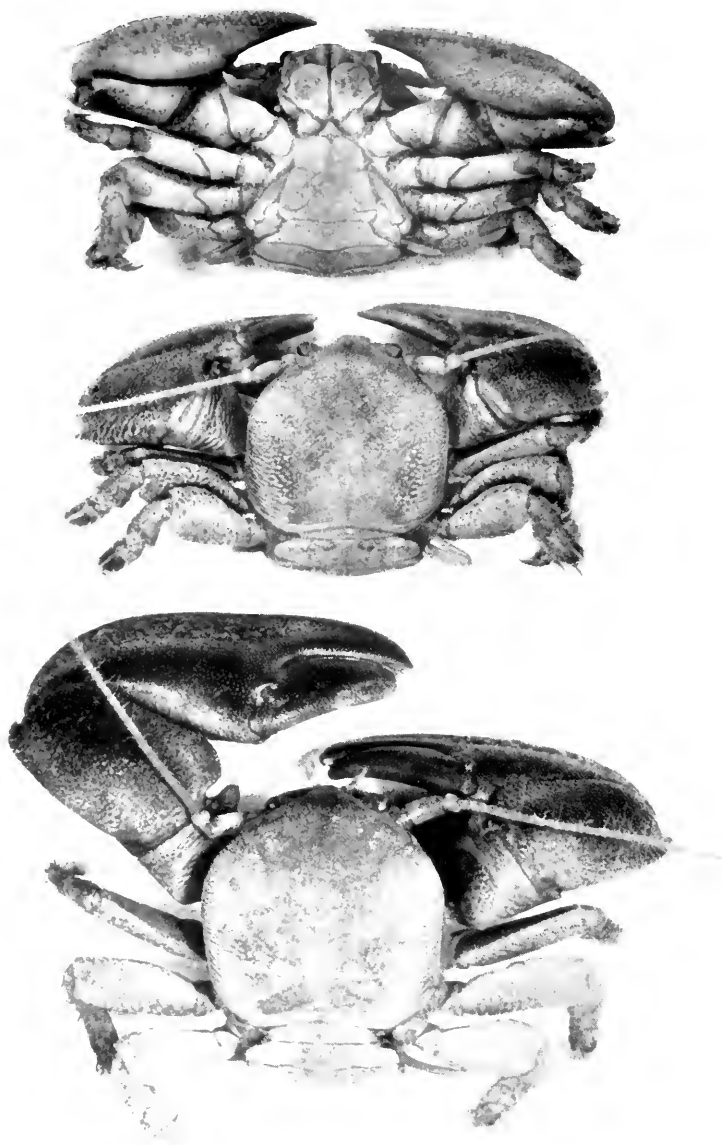
Sixty-three specimens which form an excellent series of growth stages of the species, from post-larval forms to very large old adults, were examined.

Forty-five of these, of various ages, are typical in the number and arrangement of spines on the first three abdominal somites. On the remainder the variation existent in the number of spines occurring on the first, second and third abdominal somites is as follows: the Roman numerals represent the somites I, II and III, the Arabic numerals the number of spines present, the sequence of these numerals represents the somite on which they occur. Large specimens: I, 12; II, 4; III, 4; I, 6; II, 6, III, 6; I, 4; II, 6; III, 6; I, 8; II, 8; III, 6; I, 4; II, 6; III, 4; I, 4; II, 4; III, 4.

Medium size specimens: I, 3; II, 5; III, 5; I, 2; II, 5; III, 4; I, 2; II, 4; III, 3; I, 2; II, 4; III, 5; I, 2; II, 5; III, 4.

Quite small specimens, with carapace 20 millimeters long; I, 2; II, 2; III, 2; I, 0; II, 2; III, 4; yet smaller specimens, with transverse carinae less impressed and nearly devoid of spines everywhere: specimen with carapace 16.5 millimeters long, I, 0; II, 0; III, 0; specimens with carapace 14 millimeters long: I, 0; II, 0; III, 0; specimen with carapace 12 millimeters long: I, 0; II, 0; III, 0; specimen with carapace 10 millimeters long: I, 0; II, 0; III, 0.

REFERENCES: *Munida gregaria*, BOONE, L., Bull. Vanderbilt Marine Mus., Vol. III, 1930, p. 53, pl. with synonymy).



Petrolishtes granulosa (Guerin de Meneville), from Clotilde Island, Chiloe Archipelago, Chile. The upper and median figures are of a specimen of average size, while the lower one is a very large specimen.

Family: PORCELLANIDAE

Genus: PETROLISTHES Stimpson

Petrolisthes granulosa (Guerin de Meneville)

1

Plate 108

TYPE: *M. Guerin de Meneville's* type was collected "on the coasts of Valparaiso, Chile, and deposited in the Paris Museum; his text was published in 1835 and figured in 1838. Dr. Henri Milne Edwards published a description, apparently based on the same specimens, under the name *Porcellana striata* in "Suites a Buffon," edition Roret, 1837. The type of Mr. J. W. Randall's *Porcellana cinctipes* was collected by Mr. Thomas Nuttall and is deposited in the Philadelphia Academy of Natural Sciences. The type of *Porcellana rupicola* Stimpson (1857), which has long been accepted as synonymous with *P. cinctipes*, was obtained on the California coast, in the littoral zone, at the Farallones, San Luis Obispo and Monterey and deposited in the Boston Society of Natural History, the Philadelphia Academy of Natural Sciences and the Smithsonian Institute (those at the latter Institution are no longer extant). Likewise *Petrolisthes eriomereus* Stimpson (1871), taken by Mr. Alexander Agassiz, in Mendocino County, California, was deposited in the Smithsonian, and is longer extant. The type of *Porcellana valida* Dana is given as "Valaparaíso, Chile," where this species was later taken by the "Challenger"; Dana's type is in the Philadelphia Academy of Natural Sciences.

DISTRIBUTION: This interesting little crab has an extensive distribution in the littoral zone of the west coast of the Americas, ranging from southern Chile northward to Vancouver Island, British Columbia, on the mainland; it has also been taken in the Galapagos Islands and at Hawaii. The following records for it have been published: As *granulosa* or *striata*: Chile, coasts of Valparaiso (Guerin; Milne Edwards), on shore of Clotilde Islands, Chiloe Archipelago (Boone); as *cinctipes* or *rupicola*: Sandwich Islands (Randall); Vancouver Island (Newcombe; Bate); littoral zone of the California coast at Farallones, San Luis Obispo, Monterey (Stimpson); Santa Barbara, Santa Catalina Island, San Diego, San Miguel, west coast of Lower California and Gulf of California (Lockington, Holmes, Ortmann); Laguna Beach, California, (Baker); San Francisco Bay, on rocks

(Schmitt); Galapagos Islands, at "Arcturus" station 54, Hood Island (Boone). As *eriomerus*: Mendocino County, California (Stimpson); Humboldt County to San Francisco Bay, California (Holmes); California coast (Lockington); north shore of Tabogilla Island, Bay of Panama and Gardner Bay, Hood Island, Galapagos Islands, 2.5 fathoms (Boone). As *valida*: Valparaiso, Chile (Dana); Valparaiso Beach, Chile and Messier Channel, South America (Henderson).

MATERIAL EXAMINED: Eight specimens, taken on the shore of Clotilde Island, Chiloe Archipelago, Chile, February 12, 1935, by the "Alva."

DISCUSSION: Examination of the eight little *Porcellanid* crabs from the Chiloe Archipelago directed attention to the long neglected report of M. Guerin de Meneville on the "*Crustaces du Voyage de la Favorite*" (1835, also 1838), and the fact that the present specimens of the Vanderbilt South American Expedition of 1935 are identical with M. Guerin de Meneville's (1835) type of *Porcellana granulosa* from Valparaiso, as figured by him a hundred years ago, which automatically has priority over Dr. Henri Milne Edwards' *Porcellana striata* (1837) based on the de Meneville types. This led to a review of Mr. J. W. Randall's *Porcellana cinctipes* (1839), described from the Hawaiian Islands, with which species *Porcellana rupicola* Stimpson (1857) from the littoral zone of the California coast at the Farallones, San Luis Obispo and Monterey, has long been accepted as synonymous.

Likewise, *Petrolisthes eriomerus* Stimpson (1871), taken by Mr. Alexander Agassiz, in Mendocino County, California, and first illustrated by Mr. S. J. Holmes (1900), who gave a figure of the chelipeds only, based on additional specimens taken in California, from Humboldt County to San Francisco and Mendocino, appears to be only a variety of *granulosa*. As pointed out by Mr. Stimpson (1857), his species *P. rupicola* has its affinities with *Petrolisthes valida*, *P. violacea* and *P. granulosa*, from which he distinguishes *rupicola* by the smooth anterior margin of its carapace. As stated by Mr. Lockington (1878), *P. eriomerus* is but a variety of the earlier described *P. rupicola* Stimpson; Mr. Lockington's statement being based upon examination of a series of specimens from California which showed the intergrading of the alleged specific characters of *P. eriomerus* with *P. rupicola*.

Mr. Stimpson's figure of *P. rupicola* (1857, pl. 19, fig. 2), shows the carpus of the cheliped 14.5 millimeters long, 8.5 millimeters wide, the carapace 17 millimeters long and 17 millimeters wide. Of his *P. eriomerus*, he states, "Chelipeds (except at the fingers) granulated, carpus rather elongated, with a straight and entire anterior margin destitute of a prominent inner lobe, and a denticulated posterior margin; hand with a tuft of hair between the fingers below. Ambulatory feet everywhere hairy on upper edge. Surface of meros of third pair also hairy."

Examination of all available material and records, including the present Chilean series of specimens, shows in the specimens examined a range in the length of the carpus of chelipeds from width equal to length, 5 millimeters long and 5 millimeters wide on the right, regenerated chela, with a 10 millimeters wide and 15 millimeters long, or 1.5 times as long as wide, carpus on the opposed left chela of the same male, to specimens having a one and one-third to one and one-half, or one and three-fourths to twice as long as wide, carpal joint of the chelipeds.

In Mr. Holmes' illustration of the cheliped of *eriomerus*, actual measurement of the drawing shows the carpus to be two and one-half times as long as wide, but no certainty exists, nor does the drawing itself indicate, that it was done to scale.

In the thirty-odd specimens examined by the present writer a wide individual variation exists also in the degree of granulation of the carapace and legs, varying from smooth or finely punctuate, in the soft-shell specimens and "peelers" to partially granulose and very granulose, the large old males and females usually showing the greatest amount of granulation and branchial striation, but in instances of regenerated chelae possessing simultaneously with such granulose bodies, smooth or nearly smooth chelipeds.

The prominence of the inner lobe of the carpus is also too variable to be counted a species character, being actually larger in the old specimens, appearing larger in those with shortened carpal joints and being reduced in soft shell forms or even absent in the regenerated legs.

All specimens examined have the ambulatories setigerous on the distal three articles and in greater or less degree also on the merus of the third pair of legs, this setigerous condition being conspicuous on young specimens and also on a few of those from

the Gulf of California, while on the Galapagan, Panamanian and Chilean specimens, the setae of the third ambulatory is present all over, as stated by Stimpson for his *erimerus*; the present series showing mostly short setae, which are spaced the same as when they occur long. The fourth and fifth pairs of ambulatory legs also have these setae on both the broad and narrowed upper margins of the merus.

TECHNICAL DESCRIPTION: Carapace squarish, about as wide as long, posterior- and anterolateral angles slightly rounded, a distinct, deflected postorbital angle; the interorbital region triangulate, deflected, showing quite a little variation in the degree of prominence of the triangulate apex, likewise of the median groove of this region. The cervical and hepatic grooves are distinct. The carapace is covered with low, granulose squamae, weak anteriorly, nearly smooth or coarsely punctate on the gastric and central portions, coarsely and usually regularly transversely-obliquely striate on the branchial and lateral areas, these striae being formed of continuous series of granules minutely setigerous on their anterior margin. The linear lateral margin is formed of a distinct beading of these granules. The normally subequal chelipeds are large and continuously paved with these granules, which when very abundant tend to form transversely oblique rows along the posterior margin of the carpus and normally form a small marginal beading along the anterior lateral margin, this more rarely bearing a few, irregularly distributed, coarser, dentiform granules. The merus is trihedral, short, with a blunted, knob-like process at the anterior distal angle; the carpus varies in length, from nearly equal to its own width, to one and a third, or more frequently one and three-fourths or twice this width, with the lateral margins varying from parallel in those specimens having the distal process reduced or absent, to not so, the anterolateral margins diverging distally from the postlateral margin in those specimens which have a prominent laminate process at the anterolateral angle. The distal dorsal margin of the carpus is trisinate. The propodus and dactyl are triangulate, large, the inferior lateral margin being relatively straight, the superior margin diverging distally to the base of the finger, where it unites with the slightly shorter, superior margin of the dactyl, forming the apex of the triangle; the superior margin of the dactyl converges distally meeting the inferior

margin of the dactyl. The dactyli comprise about two-fifths of the entire length of the propodus; the propodal finger is a little broader proximally than the upper finger and has the cutting edge excavate, the apex moderately upcurved; the hinged finger is swung obliquely, with the upper margin beaded or granulose, the apex rounded and bent inward and the cutting edge convex. There is a concave hiatus on the inner face of the cutting edge not visible on the external face; this hiatus is filled by a dense soft pilose brush on all specimens examined.

The Chilean specimens give the following measurements, all stated in millimeters:

Carpus of cheliped:		Carapace:	
Length	Width	Length, including rostrum	Width
17	10	20.5	19 male
15	10 normal right		
5.5	5 regenerated left	18.5	17 male
11	7	17	17 female
10	7	14	14 female
8	4, one lost	12	11 female, soft shell
11	7	14	14 female, soft shell
9	6, one lost	12	11.5

REFERENCES: *Porcellana granulosa*, GUERIN DE MENEVILLE, F. E., Bull. Sci. Nat. France, 1835, p. 115; Mag. de Zool. Paris, 1838, p. 6. no. 9, pl. 26, fig. 1.—RATHBUN, M. J., Proc. U. S. Nat. Mus., vol. XXXVIII, 1911, p. 617.

Porcellana laevigata, GUERIN, DE MENEVILLE, *loc. cit.*, 1835; also *loc. cit.*, 1838.

Porcellana striata, MILNE EDWARDS, H., Hist. Nat. Crust., 1837, t. II, p. 116.

Porcellana cinctipes, RANDALL, J. W., Journ. Acad. Nat. Sci. Phila., 1839, vol. VIII, 1839, p. 136.

Porcellana rupicola, STIMPSON, W., Proc. Boston Soc. Nat. Hist., 1857, vol. VI, p. 85; Journ. Boston Soc. Nat. Hist., 1857, vol. VI, p. 480, pl. 19, fig. 2.—BATE, C. S., in Lords, J. K., Nat. in Vancouver Is., 1866, vol. II, p. 276.

Petrolisthes rupicolus, STIMPSON, W., Proc. Acad. Nat. Sci. Phila., 1858, vol. II, ser. 2, p. 227.—LOCKINGTON, W. S., Ann. and Mag. Nat. Hist., 1878, ser. 5, vol. II, p. 396.—NEWCOMBE, C. F., Bull. Nat. Hist. Brit. Columbia, 1893, vol. I, p. 30.

- Petrolisthes cinctipes*, ORTMANN, A. E., Zool. Jahrb., f. Syst. 1897, Bd. II, p. 278.—HOLMES, S. J., Occas. Papers Calif. Acad. Sci. 1900, vol. VII, p. 107.—RATHBUN, M. J., Harriman Alaska Exped. Crustacea, Smithsonian Publ., 1904, vol. X, p. 168.—BAKER, C. F., Rept. Laguna Marine Labr. Calif., 1912, vol. I, p. 102.—SCHMITT, W. S., Univ. Calif. Publ. Zool., 1921, vol. 23, pl. 32, fig. 1 and text fig. 113.—BOONE, L., Zoologica, N. Y. Zool. Soc., 1931, vol. XIV, art. I, p. 49, fig. 15.
- Petrolisthes eriomerus*, STIMPSON, W., Ann. Lyc. Nat. Hist. New York, 1871, vol. X, p. 119.—LOCKINGTON, W. S., *loc. cit.*, 1878, p. 397.—HOLMES, S. J., *loc. cit.*, 1900, p. 108, pl. 1, fig. 15 (cheliped only).—SCHMITT, W. S., *loc. cit.*, 1921, p. 181, fig. 144 (after Holmes).—BOONE, L., *loc. cit.*, 1931 A, p. 52, fig. 16, *loc. cit.* 1931 B, p. 154, fig. 8.
- Porcellana valida*, DANA, J. D., in Wilkes, C., U. S. Explor. Exped., 1852, vol. XIII, pt. I, p. 415, Atlas, pl. 26, fig. 5.
- Petrolisthes validus*, HENDERSON, J. R., Rept. Voy. H.M.S. "Challenger," Zool., 1888, Anomura, p. 105.

CIRRIPEDIA

1

These three species of barnacles are presented because of their incidence on four species of deep water crabs, one deep water sea urchin and the flotsam pen of a very rare cephalopod mollusk, which are discussed elsewhere in this bulletin. Two of these barnacles are pedunculate,—*Lepas anserifera* Linné, seated on the pen of the little known squid, *Sepia smithi* Hoyle, a mollusk obtained by the "Challenger" off Papua, New Guinea, and not reported since; fifty odd specimens of this barnacle being taken by the "Ara" in the Indian Ocean. The second pedunculate barnacle is the East American deep water species, *Poecilasma inaequilaterale* Pilsbry, of which over a hundred specimens were taken, seated on four species of crabs, *Cancer borealis* Stimpson, first reported as a commensal host for this barnacle by the writer in 1930, from specimens taken by the "Ara" and the two rare spider crabs *Rochinia crassa* (A. Milne Edwards) and *Anasimus*

fugax A. Milne Edwards and the rare *Geryon quinquedens* S. I. Smith, from four stations off south Florida, in depths varying from 80, to 100 and 200 fathoms.

The sessile barnacle, *Verruca alba* Pilsbry is of exceptional interest, the "Alva" series of thirty-five specimens of spines of the sea urchin, *Cidaris abyssicola* (A. Agassiz) from off Sand Key Light, Florida, in 65 and 100 fathoms, being the most extensive collection of this rare and exquisitely sculptured small barnacle recorded.

CIRRIPEDIA

Family: **LEPADIDAE**

Subfamily: **Lepadinae**

Lepas anserifera Linné

✓

TYPE: Linné's type is in the museum at Upsala, labelled "*Habitat in Pelago Americano.*"

DISTRIBUTION: This species is commonly found pelagic in the temperate and tropic areas of the Atlantic, Pacific and Indian Oceans.

MATERIAL EXAMINED: Fifty specimens, attached to the three pens of a very rare Cephalopod mollusk, *Sepia smithi* Hoyle, found floating, in the Indian Ocean, March, 1929, by the "Ara" World Cruise.

DISCUSSION: Dr. Charles Darwin's classical presentation of this species, augmented by Dr. H. A. Pilsbry's more recent report on the "Cirripedia Contained in the Collections of the United States National Museum," (1907), which contains exquisite illustrations of this species, renders further description unnecessary.

REFERENCES: *Lepas anserifera*, LINNÉ, C. VON, Syst. Nat., 1767, ed. XII, p. 1109.

Lepas anserifera, DARWIN, C., A Monograph of the Sub-class Cirripedia, Vol. I, 1851, The *Lepadidae*, p. 81, pl. 1, fig. 4 (with synonymy).—PILSBRY, H. A., Bull. 60, U. S. Nat. Mus., 1907, p. 80, pl. 8, figs. 1, 3.—HOEK, P. P. C., Siboga-Expeditie, Cirripedia Pedunculata, Monogr. XXXI-a, 1907, p. 2.

Genus: **POECILASMA** Darwin
Subgenus: **POECILASMA** s. s. Pilsbry
Poecilasma inaequilaterale Pilsbry

✓

Volume III, Plate 81

MATERIAL EXAMINED: Fifty-odd specimens, attached to seven specimens of *Cancer borealis* Stimpson, dredged in 100 to 200 fathoms, off Fowey Rocks, Florida, November 29, 1935; two of these crabs, photographed in plates 86 and 88, show some of these barnacles. Fifty-odd specimens of the same barnacle, mostly larger specimens, attached to two specimens of the rare deep-water spider crab, *Rochinia crassa* (A. Milne Edwards), were also dredged in 100 to 200 fathoms, off Fowey Rocks, Florida. Fifteen specimens attached to two specimens of the crab, *Geryon quinquedens* S. I. Smith, also taken off Fowey Rocks, Florida, in 100 to 200 fathoms. Ten barnacles attached to eight specimens of the very rare spider crab, *Anasimus fugax* A. Milne Edwards, dredged in 80 fathoms, off Sombrero Light, Florida, January 23, 1933. All of the above series were collected by the "Alva."

REFERENCES: *Poecilasma inaequilaterale*, BOONE, L., Bull. Vanderbilt Marine Mus., Vol. III, 1930, p. 214, pl. 81 (complete discussion).

Family: **VERRUCIDAE**
Genus: **VERRUCA** Schumacher
Verruca alba Pilsbry

✓

Plate 109

TYPE: Two specimens attached to a sea urchin spine, taken in 45 fathoms, in the straits of Florida, "Albatross" station 2317, deposited in the United States National Museum, constitute the type series of this species.

DISTRIBUTION: The above cited material, specimens from an "Albatross" station in the Gulf Stream, off Hatteras, North Carolina, in 68 fathoms, a large series of specimens from an "Eolis"



Puccinellasma inaequilaterale Pilsbry, $\times 2$, attached to a portion of a cheliped of the deep-water spider crab, *Rochinia crassa* (A. Milne Edwards), from off Fowey Rocks, Florida, in 100 to 200 fathoms. (See plates 77 and 78).

station on the Pourtales Plateau, 10 miles south of Key West, Florida, on spines of *Dorocidaris* (a sea urchin), specimens from a "Blake" station, off Florida, in 195 fathoms on *D. abyssicola* (A. Agassiz), and the present series, collected by Mr. Vanderbilt, on sea urchins, from off Sand Key Light, Florida, in 65 and 100 fathoms, represent the known distribution of this very beautiful small barnacle.

MATERIAL EXAMINED: Ten barnacles sessile on the primary spines of the sea urchin, *Cidaris abyssicola* (A. Agassiz), dredged in 100 fathoms, nine miles off Sand Key Light, Florida, March 11, 1936. Twenty-five barnacles sessile on the primary spines of fourteen specimens of the identical species of urchin, dredged in 65 fathoms off Sand Key Light, Florida, November 25, 1935; both series dredged by the "Alva."

DISCUSSION: The thirty-five specimens of the present series include representatives of various growth stages of the species, from very young to quite large adults, and correspond in all diagnostic characters with the excellent descriptions and illustrations of the species presented by Dr. Pilsbry.

REFERENCES: *Verruca nexa alba*, PILSBRY, H. A., Bull. 60, U. S. Nat. Mus., 1907, p. 107, pl. 11, figs. 7, 8.

Verruca alba, PILSBRY, H. A., Bull. 9, Ibid, 1916, p. 25, pl. 2, figs. 1, 1-b, 2.

PART VI
MOLLUSCA

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PART VI
SYSTEMATIC DISCUSSION
MOLLUSCA

The mollusca herein reported represent only a very small percentage of the valuable mollusk collections secured respectively by the "Ara" World Cruise of 1928-1929, the "Alva" World Cruise of 1931-1932, the "Alva" Mediterranean Cruise of 1933 and the "Alva" South American Cruise of 1935.

The Amphineura are represented by three species, namely: *Chiton marquesanus* Pilsbry, hitherto known only from the type, a unique from the Marquesas, deposited in the Philadelphia Academy of Natural Sciences, is represented in the "Alva" collection by two fine specimens from Anaho Bay.

Two specimens of *Tonicia confossus* (Gould) from the Fiji Archipelago appear to be the second record of this species from Gould's type locality, as well as the second deposit of this interesting *Chiton* in an American museum. It is more abundantly represented in the Linnean Society's collection in London and in the "Siboga" material at Leyden.

The Australian species, *Liolophura gaimardi* de Blainville, which is very rare in American collections, was obtained at Falcon Island, Palm Islands, Queensland.

The Nudibranchiata are represented by only one species, a magnificent specimen, *Platydoris cruenta* (Quoy and Gaimard), which is apparently the only representative of this exquisite inhabitant of the tropic Pacific deposited in an American museum. This species, so many times reported from the New Guinea-Dutch East Indies area, now has its distribution extended to Samoa by the "Alva" record.

Only seven pulmonate Gastropoda are discussed in this report, two of these species being represented by larval forms. The "Alva" record of a young specimen of the exquisite *Haliotis naevosa* Martyn appears to be the first record of it from Bali. An interesting clutch of egg-capsules of the gigantic ovoviviparous *Cymbium flammeum* Bolten, from Southport, Australia, seems to be the first example of this remarkable gastropod in an American museum. The nidamental capsule of *Megalatractus aruanus* (Linné) from

Falcon Island is also of interest. A valuable series of *Siphonaria gigas* G. B. Sowerby, from Cantadora Island, Perlas Islands, also several *Nacella aenea* variety *magellanica* Gould from Chiloe Archipelago, Chile, were obtained by the "Alva" South American Cruise of 1935. Two exceptionally fine specimens of the rare *Helcioniscus argentatus* Sowerby were collected by the "Ara" World Cruise of 1928-1929, in Hilo, Hawaii. A single specimen of *Cymatium nodiferum* (Lamarck) was taken at Casa Blanca, Morocco, by the "Alva" Mediterranean Cruise of 1933.

The Pelecypoda include these species: *Arca (Navicula) avelana* (Lamarck) from the Society Islands; a single specimen of the pearly *Isognomon perna* (Linné) from Falcon Island; a magnificent specimen of Reeve's *Pteria (Electroma) electrina* from Samoa; young specimens of *Pinctada margaritifera* (Linné) from the Society Islands and Palm Islands; a specimen of *Pecten zealandiae* Gray from Samoa, establishing a new locality for this apparently rare *Pecten*; a specimen of *Pecten jacobaeus* Linné from Venice; specimens of the widely distributed *Spondylus nicobaricus* Chemnitz from Palm Islands; also several specimens of the delicately beautiful *Lima (Limaria) fragilis* (Gmelin) from this locality, a species which is but sparsely represented in American collections; a young *Ostrea cucullata* Born, likewise from Falcon Island. An excellent series of the rare *Cultellus scalprum* (Gould) was secured in Sourabaya, Java; this species was hitherto represented in American museums by the type only.

The Cephalopod collection, though small, contains some unusually interesting specimens. The rediscovery of the "Challenger" species, *Loligo kobeensis* Hoyle, hitherto published only from the type material, one adult and four immature specimens, taken in Japan and deposited in the British Museum of Natural History, but now represented in the Vanderbilt collection by three adults from Georgetown, Penang, Malay Straits, greatly extends the southeastern Asiatic distribution of this species. The collection was also augmented by additional material of *Loligo diomedae* Hoyle from the Pacific Coast of Panama, also from Valparaiso, Chile. The rather rare *Loligo indica* Pfeffer, collected in series, by the "Ara" World Cruise at Cebu, Cebu Island, Philippine Islands, establishes the first record of it in this archipelago as well as extends the northern distribution of the species. These are the only specimens of *L. indica* deposited in an American museum.

The "Alva" World Cruise obtained several specimens of *Sepioteuthis mauritiana* Quoy and Gaimard in Noumea, New Caledonia, establishing a new distribution record for this species, which greatly extends its geographic distribution. So far as published records show, *S. mauritiana* appears to be absent from the collections of American museums.

Larval forms of the exquisite little Oegopsid, *Abraliopsis morisii* (Verany) from Flores Straits and of the sea-arrow, *Ommatostrephes sagittatus* (Lamarck), from off Canary Islands, were secured. An extensive series of *Onychoteuthis banksii* Leach was taken by the "Ara" in the Sulu Sea, off the Zamboangan coast of Mindanao.

The rare *Sepia rouxii* d'Orbigny was taken in series by the "Alva" in Georgetown, Penang, Malay Straits. The largest of the Mediterranean *Sepiidae*, *Sepia officinalis* Linné was taken at Naples, by the "Alva" Mediterranean Cruise.

The rare and exquisite little Hawaiian Sepiolid, *Euprymna scolopes* Berry, was taken in Kewalo Bay, by the "Ara" World Cruise.

The Octopoda are represented by six species, five of which are members of the littoral fauna of the Indo-Pacific region, while the sixth species is an abyssal octopod from the continental shelf of the southeastern United States. These littoral octopods include the widely distributed *Octopus* (*Octopus*) *rugosus* (Bosc), of which an exceptionally fine series was secured in the Marquesas, the Society Islands, Seba-Seba Bay, Durian Straits and the harbor of Southport, Australia, collected by the "Alva" World Cruise; young forms of *Octopus* (*Octopus*) *horridus* d'Orbigny from the Red Sea; *O. (O.) cyanea* Gray from Hawaii; *O. (O.) macropus* Risso from the Marshall Islands, a locality record of especial interest for this species and the seldom captured *O. (O.) ornatus* Gould of Hawaii, these last four species being taken by the "Ara" World Cruise.

The deep-water octopod, *Bathypolypus arcticus* Prosch, as its name indicates, is an inhabitant of the European and east American Arctic waters, known as far south as southwest Ireland and South Carolina. The "Alva" collected two fine specimens off Fowey Rocks, south Florida, in a depth of 100 to 200 fathoms, thus substantially extending the southern range of this bathypelagic octopus.

The species discussed have the following distribution :

Chiton marquesanus Pilsbry, Anaho Bay, Nuka Hiva Island, Marquesas Islands.

Tonicia confossus (Gould), Vita Levu, Suva, Fiji Islands.

Liolophura gaimardi de Blainville, Falcon Island, Palm Islands, Queensland.

Haliotis naevosa Martyn, Temukus Roads, Bali, Dutch East Indies.

Platydoris cruenta (Quoy and Gaimard), Pago-Pago, Samoa.

Siphonaria gigas G. B. Sowerby, Cantodora Island, Pearl Islands, Panama Bay.

Nacella aenea Martyn var. *magellanica* Gould, Clotilde Island, Chiloe Archipelago.

Helcioniscus argentatus Sowerby, Hilo, Hawaii.

Megalatractus aruanus (Linné), Falcon Island, Palm Islands, Queensland, Australia.

Cymbium flammeum Bolten, Southport, Australia.

Cymatium nodiferum (Lamarck), Casa Blanca, Morocco, Mediterranean Sea.

Arca (Navicula) avellana Lamarck, Teviatea Reef, Raiatea Island, Society Islands.

Isognomon perna (Linné), Falcon Island, Palm Islands, Queensland.

Pteria (Electroma) electrina Reeve, Pago-Pago, Samoa.

Pinctada margaritifera (Linné), Falcon Island, Queensland, also Raiatea Island.

Pecten jacobaeus (Linné), Venice, Italy, 33 fathoms.

Pecten zealandiae Gray, Pago-Pago, Samoa.

Spondylus nicobaricus Chemnitz, Falcon Island, Palm Islands, Queensland.

Lima (Limaria) fragilis (Gmelin), Falcon Island, Palm Islands, Queensland.

Ostrea cucullata Born, Falcon Island, Palm Islands, Queensland.

Tridacna crocea Lamareck, Raiatea Island and Tahiti, Society Islands.

Cultellus scalprum (Gould), Sourabaya, Java.

Loligo kobiensis Hoyle, Georgetown, Penang, Malay Straits.

Loligo diomedee Hoyle, Panama City, Panama, Pacific Ocean.

Loligo indica Pfeffer, Cebu, Cebu, Philippine Islands.

Sepioteuthis mauritiana Quoy and Gaimard, Noumea, New Caledonia.

Abraliopsis morisii (Verany), Flores Strait, near Larantuka Village, Flores Islands, Dutch East Indies.

Onychoteuthis banksii Leach, Sindangan, northwest Mindanao, Philippine Islands.

Ommatostrephes sagittatus (Lamarck), off Fuerte Ventura, Canary Islands, 250 fathoms.

Sepia rouxii d'Orbigny, Georgetown, Penang, Malay Straits.

Sepia officinalis Linné, Naples, Italy.

Euprymna scolopes Berry, Kewalo Bay, Honolulu, Hawaii.

Octopus (Octopus) rugosus (Bosc), Marquesas Islands, Society Islands, Seba-Seba Bay, Durian Straits, Dutch East Indies and Southport, Australia.

Octopus (Octopus) horridus d'Orbigny, Makawa Islands, Red Sea.

Octopus (Octopus) cyanea Gray, Hilo, Hawaii.

Octopus (Octopus) macropus Risso, Jebwar, Jaluit Island, Marshall Islands.

Octopus (Octopus) ornatus Gould, Oahu, Hawaii.

Bathypolypus arcticus (Prosch), off Fowey Rocks, south Florida, 100 to 200 fathoms.

Class: AMPHINEURA
Order: POLYPLACOPHORA
Family: CHITONIDAE
Subfamily: Chitoninae
Genus: CHITON Linné
Chiton marquesanus H. A. Pilsbry

Plate 110

TYPE: Dr. Pilsbry's type was presented to the Philadelphia Academy of Natural Sciences by the late Andrew Garrett and was labelled "*C. marquesana*," but whether this name was given by Mr. Garrett or Dr. Tryon was unknown to Dr. Pilsbry, who presented the original description and figures of this exquisite Chiton. His type, a unique, measures: length, 46 millimeters; width, 26 millimeters.



Text figure 15.—Transverse section of girdle of *Chiton marquesanus* Pilsbry, greatly enlarged.

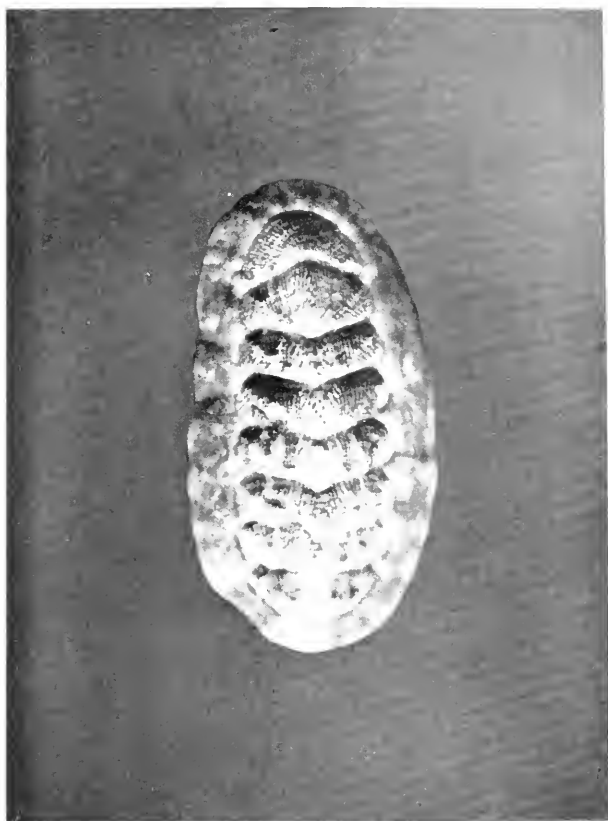
DISTRIBUTION: Marquesas Islands (Pilsbry, Boone).

MATERIAL EXAMINED: Two specimens, taken from the rocks at Anaho Bay, Nuka Hiva Island, Marquesas Islands, Pacific Ocean, August 10, 1931.

TECHNICAL DESCRIPTION: *Colour*: Dorsally dark olive green, nearly black on the lateral areas and terminal valves. Girdle dark green. Interior light blue, stained at the sinus and under the beaks with purplish brown.

Measurements: The smaller specimen has a length of 30 millimeters and a median width of 16 millimeters, the larger specimen is 48 millimeters long and 26 millimeters wide.

Shell: This chiton is oblong-ovate, depressed, obtusely carinated, with the side slopes nearly straight. The surface appears smooth and polished on the central areas and granulose and lustreless on the lateral areas, to the unaided eye. Under magnification



Chiton marquesanus Pilsbry, $\times 2$, from rocks, Anaho Bay, Nuka Hiva Island, Marquesas Islands.

the central areas show faint transverse "growth" lines and minute but regular and numerous punctae, forming a pattern of continuous dots.

Anterior valve: This is finely sculptured, with numerous conical granules, arranged closely in an irregularly radiating pattern, these granules being fine near the apex and increasing substantially in size toward the circumferal margin. The surface between the big granules is microscopically granulose. There are twenty-one slits present.

Intermediate valves: These six valves have the jugum moderately but definitely elevated and the surface of the central areas is faintly marked transversely by obscure growth lines and is regularly finely punctate, these punctae forming a fine pattern of dots in the interstices between the vague low worn granulations. The lateral areas are but little elevated, each being sculptured with about seven oblique, uneven and unequal rows, composed of low, irregular verrucae, those forming the outermost rows being placed longitudinal with the valve, while those verrucae forming the five intermediate rows have their length parallel the width of the pleural area. The entire pleural surface between these verrucae and occasionally of the verrucae also is microscopically granulose. Each intermediate valve has one slit.

Posterior valve: This has the umbo very near the anterior margin. The surface of this valve, like that of the anterior valve, is finely sculptured with numerous conical granules, arranged closely in irregularly radiating lines, these granules being fine near the umbo and increasing in size toward the circumferal margin, the surface between the verrucae being finely granulose. There are twenty-five slits present.

Girdle: In the preserved specimens, this is 6 millimeters wide, deep olive green, covered with imbricating scales set in twelve or thirteen rows, of which the median rows of scales are much the larger, the other scales decreasing in size toward both the inner and outer lateral margins. The scales are very convex, the larger ones also being carinate.

REFERENCES: *Chiton marquesanus*, PILSBRY, H. A., and TRYON, G. W., Manual of Conch., vol. XIV, Polyplacophora, 1892, p. 170, pl. 36, figs. 98, 99, 100 (Colour plate).—NIERSTRASZ, H. B., Siboga-Expeditie, monogr. XLVIII, 1905, p. 87.

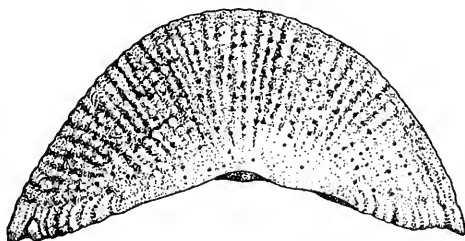
Subfamily: **Toniciinae**Genus: **TONICIA** Gray**Tonicia confossus** (Gould)

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Plate 111

TYPE: Gould's type was collected in the Fiji Islands by the United States Exploring Expedition and is deposited in the Boston Society of Natural History.

DISTRIBUTION: Littoral zone, Fiji Archipelago (Gould, Tryon, Boone); Mer, Murray Island, Torres Straits (Melvill and Standen); at six "Siboga" stations: Timor, Borneo-Bank, Sulu Archipelago, Damar Island, Banda and a reef, station 299.



Text figure 16.—*Tonicia confossus* Gould: anterior valve, showing the eyes, greatly enlarged.

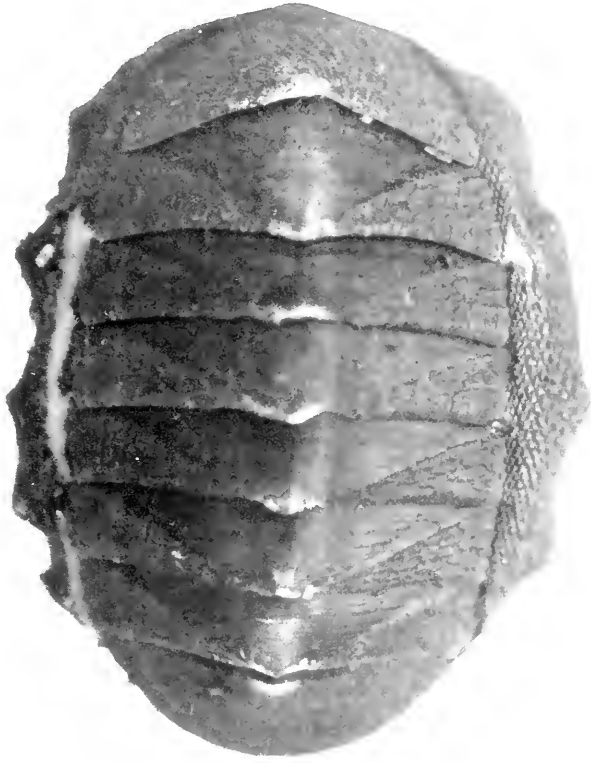
MATERIAL EXAMINED: Two specimens, taken in Vitu Levu, Suva, Fiji Islands, September 9, 1931, by the "Alva."

TECHNICAL DESCRIPTION: *Colour:* Ashy white, delicately maculated with shades of reddish and purple-brown, the darker colour irregularly tessellating the posterior margin of each valve. Girdle blackish brown. (Tryon).

Shell: This is oblong-oval, elevated, decidedly costulate longitudinally; the mucro of the posterior valve is very prominent.

Measurements: Specimen A: long diameter, 16 millimeters; short diameter, 8 millimeters; specimen B: long diameter, 15.8 millimeters; short diameter, 7.8 millimeters. Girdle included in above measurements.

Anterior valve: This is regularly convex, with the apex at the median part of the posterior margin, from which are radiating series of imbricating, shingle-like scales, predominantly V-shape, with the apex of the V forward-directed, each of these elevations, or ridges, alternating with narrowed, depressed linear grooves



Tonicia confossus (Gould), $\times 6$, from Vitu Levu, Suva, Fiji Islands.

in which the well-separated eyes occur. There are eight to nine eyes per line, in the median central area, corresponding to the same number of imbricated squamae and so arranged that the eye is placed in the wider, interstitial area, between the narrowed apices of the elevated squamae, so that the eyes form approximate series, arranged in concentric semicircles, alternating with similar concentric series of separated squamae. In the lateral area the squamae on the outer half are thickened and arranged in ridges longitudinal with the animal, more prominent and somewhat tending toward an angle with the radiating series. There are eight slits present.

Intermediate valves: In specimen A, the dorsal or jugal area of the anterior two-fifths is imbricated, and of the posterior three-fifths of the first intermediate valve and of the entire jugum of the remaining intermediate valves is a smooth, white ridge, microscopically punctate, with the squamae entirely fused, while in specimen B, the ridge is present, but less complete, the squamae imperfectly fused; on these the first intermediate valve being scarcely differentiated from those of the adjacent pleural regions, except on and near the beak. In both specimens the intermediate valves are moderately beaked, the apices being in the mid-posterior region. The pleural areas are decorated by lines of imbricated squamae, ▲ in shape, like those of the anterior valve, but arranged on the intermediate valves in approximate longitudinal series and alternating, as on the anterior valve, in alternation with grooves in which the eyes are more sparsely distributed. Immediately posterior to the diagonal line the eyes are very numerous, being more closely spaced and covering a narrowed, triangular portion of the lateral area, the apex of which ocular triangle is near the beak and is one eye wide on the second valve, becoming four eyes wide distally; on valves three, four, five, six and seven, the ocular triangle begins as one eye wide at the apex, widens medially to three eyes wide and distally to five to six eyes wide along the outer margin. The squamae between the eyes are present but subdued, while on the remainder, or posterior portion of the respective lateral areas, the squamae are coarse, arranged in somewhat radiating series from the beak outward with the distinct one alternating grooves nearly devoid of eyes. The diagonal line is ridge-like, composed of these prominent, imbricate squamae. There is one slit present to each intermediate valve.

The sutural plates have a widely, deep, rounded contour anteriorly, and one each about three-fifths as deep as the related adjacent posterior area of the valve. The sutural plates of a valve have a median sinus between them about one-half as wide as one plate. In the second valve this is smooth, but in the remaining valves it is finely denticulate. There is one slit present in each intermediate valve; the teeth are sharply, deeply pectinated outside. The eaves are narrowed, projecting slightly downward just above and very narrowly grooved outside of the teeth.

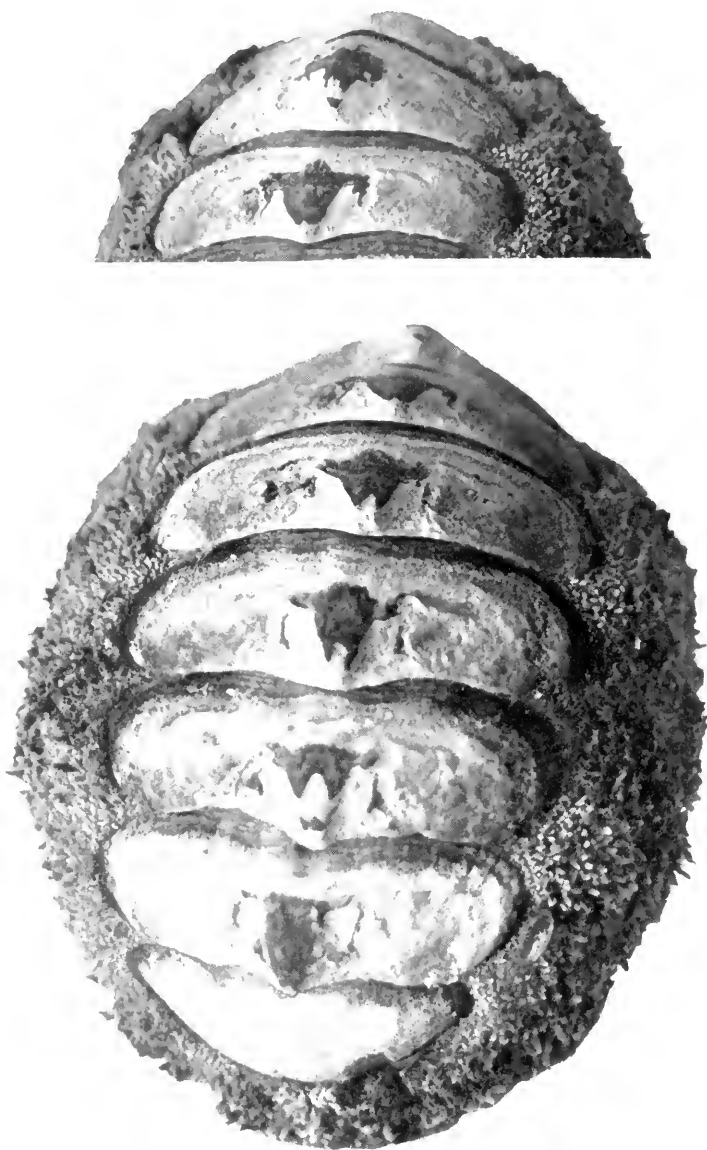
Posterior valve: This has a very prominent mucro near the posterior end, the median area anterior to it being horizontal, the slope behind it being vertical. The jugum anterior to the mucro is similar to that of the preceding valve. The pleural areas are marked with radiating lines of squamae alternating with grooves, nearly devoid of eyes. The vertical region posterior to the mucro drops vertically from the diagonal line, is convex, covered, except near the mucro, with radiating lines of imbricate squamae, alternating with linear grooves in which the eyes are very numerous, in concentric series, especially abundant just behind the mucro, but also occurring regularly spaced (as on the anterior valve) in the grooves between the ridges down to the outer margin of the valve. There are fifteen slits present, these being rather shallow; the posterior teeth somewhat directed forward and deeply pectinated.

REFERENCES: *Chiton confossus*, GOULD, A. A., Proc. Boston Soc. Nat. Hist., July, 1846, p. 143; in Wilkes, U. S. Explor. Exped. Mollusca, 1852, vol. XII, pp. 143, 327; atlas, vol. XII, pl. 35, figs. 434-a, b; *Otia conchologica*, p. 5.

Chiton (Lucia) confossus, GOULD, A. A., *Otia Conch.*, 1846, p. 242.

Lucia confossa, GOULD, A. A., Proc. Boston Soc. Nat. Hist., 1862, vol. VIII, p. 283.—DALL, W. H., Proc. U. S. Nat. Mus., 1878, vol. I, p. 298.

Tonicia confossa, TRYON, G. W., and PILSBRY, H. A., *Man. Conch.*, 1892, vol. XIV, Polyplacophera, p. 210, pl. 57, figs. 33-36.—MELVILL, J. C., and STANDEN, R., *Journ. Linn. Soc. London, Zool.*, 1899, vol. XXVII, No. 174, p. 180.—NIERSTRASZ, H. F., *Siboga-Expeditie*, monogr. XLVIII, 1905, p. 90, pl. 2, fig. 31, pl. 6, 165.



Liolophura gaimardi (de Blainville), $\times 2$, from the reefs, Falcon Island, Palm Islands, Queensland.

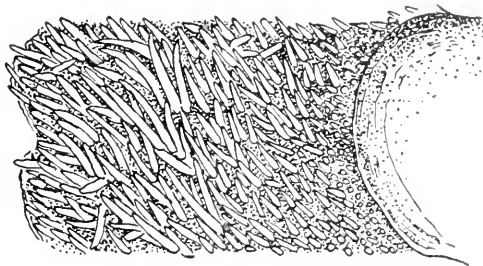
Subfamily: **Liolophurinae** PilsbryGenus: **LIOLOPHURA** Pilsbry**Liolophura gaimardi** de Blainville

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Plate 112

TYPE: This was collected in Port Jackson, New South Wales, and is deposited in the Paris Museum.

DISTRIBUTION: Port Jackson, New South Wales (de Blainville, Coppinger, Haddon) ; New South Wales (Gould) ; Australia (Pilsbry) ; Falcon Island, Palm Islands, Queensland (Boone).



Text figure 17.—Transverse section of girdle of *Liolophura gaimardi* de Blainville, greatly enlarged.

MATERIAL EXAMINED: Five specimens, from the reefs, Falcon Island, Palm Islands, Queensland, Australia, October 7, 1931.

TECHNICAL DESCRIPTION: *Colour*: The valves are buff-gray, marked on the jugum and sides with black. The girdle is tessellated, having alternately light and dark bands. The interior of the shell is dark red-brown, whitish on the edge of the sutural plates and valve callus. The posterior internal margin is covered by reflexed blackish brown tegmentum. The sutural plates are brownish below with white outer margin; from above they are whitish shading into reddish brown toward the median sinus. These plates are rounded, broadly separated by a very wide, deep, rounded sinus.

Shell: This is oblong, depressed, roundly arched, with a long diameter of 55 millimeters, and a short diameter of 35 millimeters, belt included, or of 48 millimeters long diameter and 22 millimeters, without the belt.

Anterior valve: This is much eroded, with the apex rounded,

with the surface concentrically wrinkled and studded with numerous eyes. There are nine slits present.

Intermediate valves: These valves are definitely beaked in the jugal area, considerably eroded and with the lateral areas but little raised, concentrically toward their bases and studded with minute scattered eyes, appearing as blackish dots. The central areas are wrinkled and have scattered eyes at the sides. Each valve has one slit.

Posterior valve: This is small, depressed, with a contour similar to that of the intermediate valves. The mucro is terminal but much eroded. Internally the posterior valve has the eaves projecting beyond the broad, flat, crescentic callus which occupies the place of an insertion plate.

Girdle: This is very wide in ratio to the shell, being as wide at the anterior end, or slightly wider than the length of the first valve and this belt width increases to the median lateral area, where this width is slightly over one-half of the width of the widest valve. The girdle is densely clothed with intermingled minute and very large calcareous spines, which are short, cylindrical, tapered a little and distally rounded. A few are bowed, but the majority are straight, conical. Some are blackish, some white and a few are streaked.

REFERENCES: *Chiton gaimardi*, DE BLAINVILLE, H. M. D., Dict. Sci. Nat. Paris, 1825, t. XXXVI, p. 546.

Chiton incanus, GOULD, A. A., Proc. Boston Soc. Nat. Hist., 1846, vol. II, p. 245; in Wilkes, U. S. Explor. Exped. Mollusks, vol. XII, 1852, p. 315; atlas XII, pl. 28, figs. 432-a; Otia Conch., 1846, p. 6.

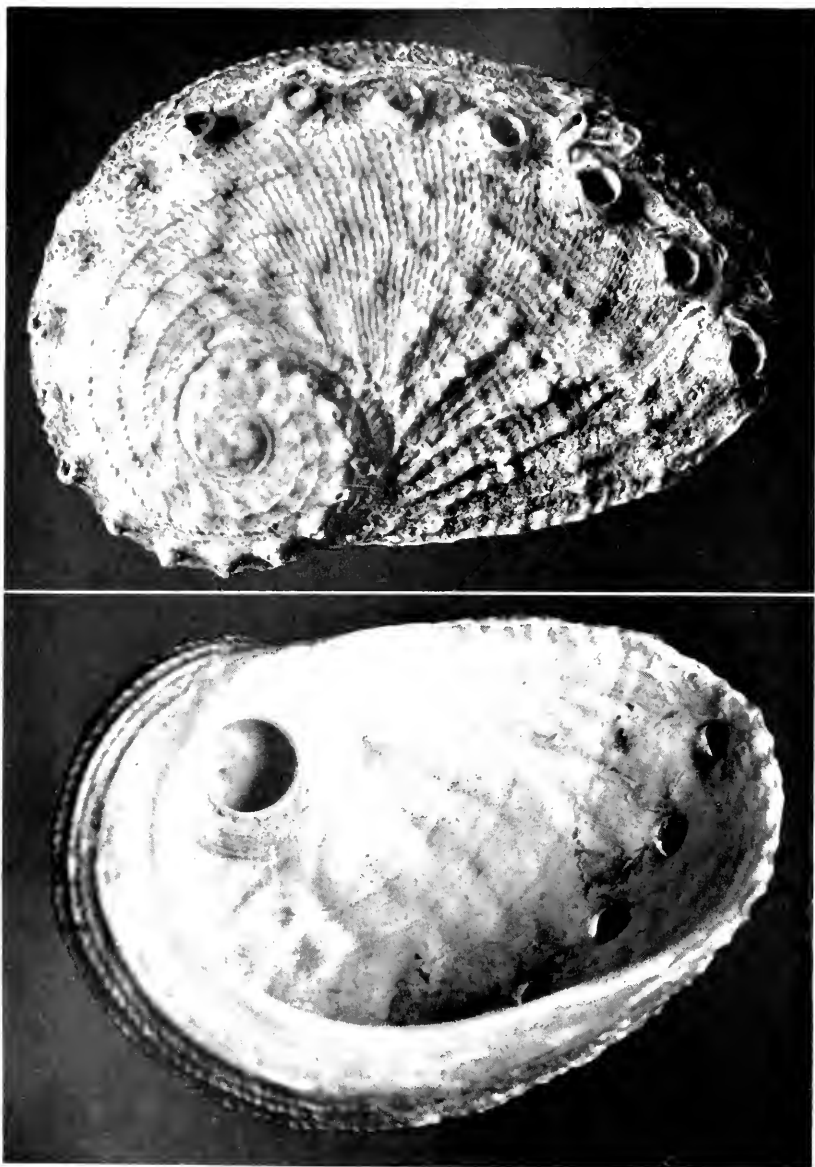
Maugeria incanus, GOULD, A. A., op. cit., p. 248.

Acanthopleura incana, SMITH, E. A., Zool. Coll. H. M. S. "Alert," publ. B. M. N. H., 1884, p. 81.

?*Chiton piceus*, ANGAS, G. P., Proc. Zool. Soc. London, 1867, p. 223.

Acanthopleura (?) incana, HADDON, A., Rept. Voy. H. M. S. "Challenger" Zool., 1886, vol. XV, Polyplacophora, p. 223. (Partim).

Liolophura gaimardi, PILSBRY, H. A., in Tryon; G. W., Man. Conch., 1892, vol. XIV, Polyplacophora, p. 240, pl. 53, figs. 3-35.—NIERSTRASZ, H. F., Siboga-Expeditie, Monog. XLVIII, 1905, p. 108.



Haliotis naevosa Martyn, $\times 4.6$, from on coral, Temukus Roads, Bali.

Class: **GASTROPODA**

Order: **PROSOBRANCHIATA**

Superfamily: **ZYGOBRANCHIA**

Family: **HALIOTIDAE**

Genus: **HALIOTIS** Linné, s. s. Lamarck

Haliotis naevosa Martyn

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Plate 113

TYPE: Martyn's exquisite figures of this species were made from a shell collected, New South Wales, between 1765 and 1780.

DISTRIBUTION: This species is known from New Holland or Australia, also listed in the early records from Van Dieman's Land; New Zealand and more recently from Bali (Boone), this "Alva" record apparently being the first from Bali.

MATERIAL EXAMINED: One young specimen, taken on coral, Temukus Roads, Bali, Dutch East Indies, October 25, 1931.

The Bali specimen is quite young, having a long diameter of only 20 millimeters, as compared with one of 98 millimeters recorded by Martini and Chemnitz. Dorsally the present shell is scarlet to a clay-red marbled with a conspicuous design of radiating irregular zigzag lines of a deep chestnut brown mingled with tones of olivaceous red. The interior surface is a silvery pearl exquisitely iridescent with green and rose.

The shell is moderately elevated, with about two- and three-quarter whorls, apex small, prominent, the apertures about twenty-nine, of which seven remain open; the dorsal margin of these being elevated, thin. Outside of the apertures the usual sulcus is present. The dorsal surface is spirally lirate, the lirations being four major ridges inside of the outer row of holes and of three major ridges outside of this outer row of holes. These ridges have the appearance of rope-coil, being formed of granules close-set but interrupted by the radiating transverse, fine incremental lines. At intervals the granules composing the ridges are enlarged, forming coarser nodules. The spire is situated well forward with subvertical lines. The interior of the shell is silvery-pearly iridescent with green-rose-lavender.

Long diameter, 21.5 millimeters; short diameter, 14 millimeters; altitude, 7 millimeters.

This species attains a much greater size than the present specimen and is one of the most strikingly coloured members of the genus found in the Indo-Pacific. Yet in its home in the tidal zone of the beautiful coral reefs this striking colour pattern of the snail merges almost invisibly with its environment.

REFERENCES: *Haliotis naevosa*, MARTYN, THOMAS, Univ. Conch., London, 1785, vol. II, fig. 63.—REEVE, L., Conch. Icon., 1856, vol. II, pl. 8, fig. 27, pl. 9, figs. 27-a-c.—SOWERBY, G. B., Thes. Conch., 1882, vol. V, 3, *Haliotis*, p. 31, fig. 39.—WIENKAUFF, in Martini, F. H. W., and Chemnitz, J. H., Syst. Conch. Cab., 1883, Bd. VI, *Haliotis*, p. 34, taf. 14, figs. 1-3.—DALL, W. H., Proc. U. S. Nat. Mus., 1906, vol. XXIX, p. 431.

Haliotis clathrata, REEVE, LOVELL, op. cit., pl. 17, fig. 72.—SOWERBY, G. B., op. cit., pl. 6, fig. 39 (young).

Order: NUDIBRANCHIATA

Suborder: Nudibranchiata Holohepatica

Family: PLATYDORIDIDAE Bergh

Genus: PLATYDORIS Bergh

Platydoris cruenta (Quoy and Gaimard)

✓

Plate 114

TYPE: M. Quoy and Gaimard's type was secured by the "Astrolabe" in New Guinea waters and deposited in the Paris Museum.

DISTRIBUTION: Indo-Pacific, New Guinea (Quoy and Gaimard); Amboina Bay; Siboga Stations: No. 78, reef, Lum-lumu Shoal, Borneo Bank; reef, No. 279, Ruma-Kuda Bay, Roma Island; No. 193, reef, Sanana Bay, east coast, Suli Besi; No. 213, reef, Pulu-Pasi-Tanette; No. 209, south spit, Kabaena Island, and No. 131, reef, Beo Bay, Karakelang Islands; all in the Dutch East Indies (Bergh); Samoa (Boone).

MATERIAL EXAMINED: One very fine specimen taken at Pago-Pago, Samoa, September 2, 1931, in shallow water.



Platydoris cruenta (Quoy and Gaimard), $\times 1.3$, from Pago-Pago, Samoa.



Siphonaria gigas G. B. Sowerby, \times about 1, dorsal ventral and profile of large specimens and dorsal of two younger specimens, all from Cantadora Island, Pearl Islands, Panama Bay.

DISCUSSION: The single specimen taken by the "Alva" conforms with the excellent description and anatomic figures given by Bergh for his *arrogans*. The colour-plate given by Bergh of the dorsal view has approximately only half so many fine lines marking the pattern as exist in the present specimen, from which the red markings are mostly faded except for a faint outline. These red spots are more like those shown in the Quoy and Gaimard plate, as are also the black lines on the ventral surface.

So far as the present writer is aware, the "Alva" specimen represents the farthest east in the Pacific that this gorgeously beautiful habitant of the tropical seas is reported to date. Unfortunately little idea of the delicate gracefulness of the living nudibranch can be portrayed. Its velvety gliding body seems a part of the sea, as exquisite as a rainbow.

REFERENCES: *Doris cruenta*, QUOY, J. R. C., and GAIMARD, J. P., Voy. de L'Astrolabe, Zool., 1832, t. II, p. 260; atlas, pl. 18, figs. 5-7.

Platydoris arrogans, BERGH, R., Malakol. Unters. in Semper, K., Reisen im Arch. Philippinen, Wiss. Resultat. II, Malakol. Unters. Heft XII, 1887, pp. 513-517, taf. 51, fig. 2, taf. 59, figs. 19-25, taf. 60, figs. 3-9; Suppl. I, 1880, pp. 58-60, taf. E, fig. 39, op. cit.; Heft XVII, 1890, p. 912, taf. 86, fig. 6, taf. 87, fig. 32-33.

Platydoris cruenta, BERGH, R., "Siboga"-Expeditie die Opisthobranchiata, 1905, Leiden, Monog. L, livr. 25, p. 136, taf. 1, fig. 3.

Order: PULMONATA

Superfamily: PTEROPHILA

Family: SIPHONARIIDAE

Genus: SIPHONARIA G. B. Sowerby

Siphonaria gigas G. B. Sowerby

1

Plate 115

TYPE: The type of *Siphonaria gigas* Sowerby was collected in the Galapagos and Panama and originally deposited in the collection of Charles Bennet, fourth Earl of Tankerville. The type

of *Siphonaria characteristic* Lovell Reeve, from the same localities, representing the more numerous and obscurely striated variety with the interior dark brown, is deposited in the collections of the British Museum of Natural History.

DISTRIBUTION: Galapagos Archipelago and Panama on the west coast (Sowerby, Reeve) ; Peruvian Province, littoral (Dall) ; Pearl Islands (Boone).

MATERIAL EXAMINED: Seventeen specimens, collected at Cantadora Island, Pearl Islands, Panama Bay, Pacific Ocean, by the "Alva," January 19, 1935.

TECHNICAL DESCRIPTION: This, the giant *Siphonaria* of the littoral zone of the subtropical and tropical areas of the west coast of the Americas, has considerable variation, even as exhibited in the seventeen specimens of the present series.

The shell is variously subcircular to long-ovate in marginal contour, elevate, cone-like with apex obtuse, frequently eroded in large specimens, subcentral to distinctly postcentral; the external surface radiately ribbed, these primary ribs frequently very strong, ridge-like, with the interstices radiately striate, these striae varying from vague to moderately strong, with an occasional much coarser secondary rib which usually becomes obsolete below the apex. Interior of shell variously opalescent smoky-pearly gray to brown to purplish black-brown. Siphon impression very distinctly delineated in the interior as a narrow incomplete band with widened scars at each end, this band being devoid of the pearly nacre (readily seen in plate 115). The exterior of the shell is variously colored, the primary and secondary ridges not infrequently being creamy white throughout their length, or cream-white with occasional concentric brown, olivaceous brown or brown-black markings; the marginal fourth of the exterior is frequently deeper brown than the remainder, which is usually lighter brown, the small apical area is frequently white in the young and non-eroded specimens; the central third or more of the very large shells being white to gray-white, due to erosion.

The dimensions and variations existent within the present series is as follows, all measurements given in millimeters:

Horizontal, Long Diameter	Horizontal, Short Diameter	Altitude	Remarks
46	44	26	Interior smoky gray-brown with greenish opalescence; about 20 primary costae.
66	54	38	About 10 primary costae.
62	46	34	Apical erosion .6; 34 primary costae with 3 secondaries between each pair.
60	50	30	Interior opalescent green, deep, smoky; 14 strong primary costae.
57	50	38	Interior dark smoky blue-gray; 48 small eroded costae.
40	34	14	Interior blackish gray, little opalescence; 12 strong primary costae.
27	23	13	Margin semistellate, irregular, 10 primary costae, very fine intermediate striae.
29	24	15	Primary costae 10, interstices fine-ribbed, margin irregular and ten-rayed. Interior steel gray-green with silvery cast.
55	45	40	Injured; greatly eroded, all primary costae eroded, secondary striae small. Interior gray-blue, iridescent.
50	40	35	12 primary costae, about as many half so coarse costae, with interstices fine-ribbed. Interior pearly gray-blue, milky, opalescent.
46	35	30	20 primary costae of medium size, eroded, with about 20 secondary striae. Interior shining steel blue-gray.
40	35	25	12 coarse primaries and 12 large secondaries, margin irregular, crenulate.
42	32	26	10 coarse primary costae, 10 secondaries with 6 to 8 fine striae per section; margin irregular, pointed. Interior opalescent, milky, silvery steel blue.
40	30	21	12 primary costae, about 6 coarse secondary costae and numerous fine striae. Interior deep gray with radiating cream lines on inner of costae, all opalescent silvery with faint rose tints.
36	30	25	10 primary costae with about as many coarse secondaries extending in part way to center, intermediate striae fine. Interior light steel gray, darker at margin with milky opalescence.
32	24	18	10 primaries and 10 eroded secondaries. Contour very irregularly oval; margin coarsely pointed.
60	45	30	Exterior badly eroded; interior also worn.

REFERENCES: *Siphonaria gigas*, SOWERBY, G. B., SR., in Ben-
net, C., Fourth Earl of Tankerville's Cat. Mollusca, Appen-
dix, 1825, p. 6.—REEVE, L., Conch. Icon., 1856, vol. IX,
Siphonaria, pl. 1, fig. 3, March, 1856.—DALL, W. H., Proc.
U. S. Nat. Mus., 1910, vol. XXXVII, pp. 205, 290.

Siphonaria characteristic, REEVE, L., Conch. Syst., 1842, vol. II,
pl. 138, fig. 3; Conch. Icon., 1856, vol. IX, pl. 2, fig. 8, of
Siphonaria.

Superfamily: **DOCOGLOSSA**

Family: **PATELLIDAE**

Subfamily: **Nacellinae Thiele**

Genus: **NACELLA** Schumacher

Section: **PATINIGERA** Dall

Nacella aenea Martyn variety *magellanica* Gmelin

Plate 116

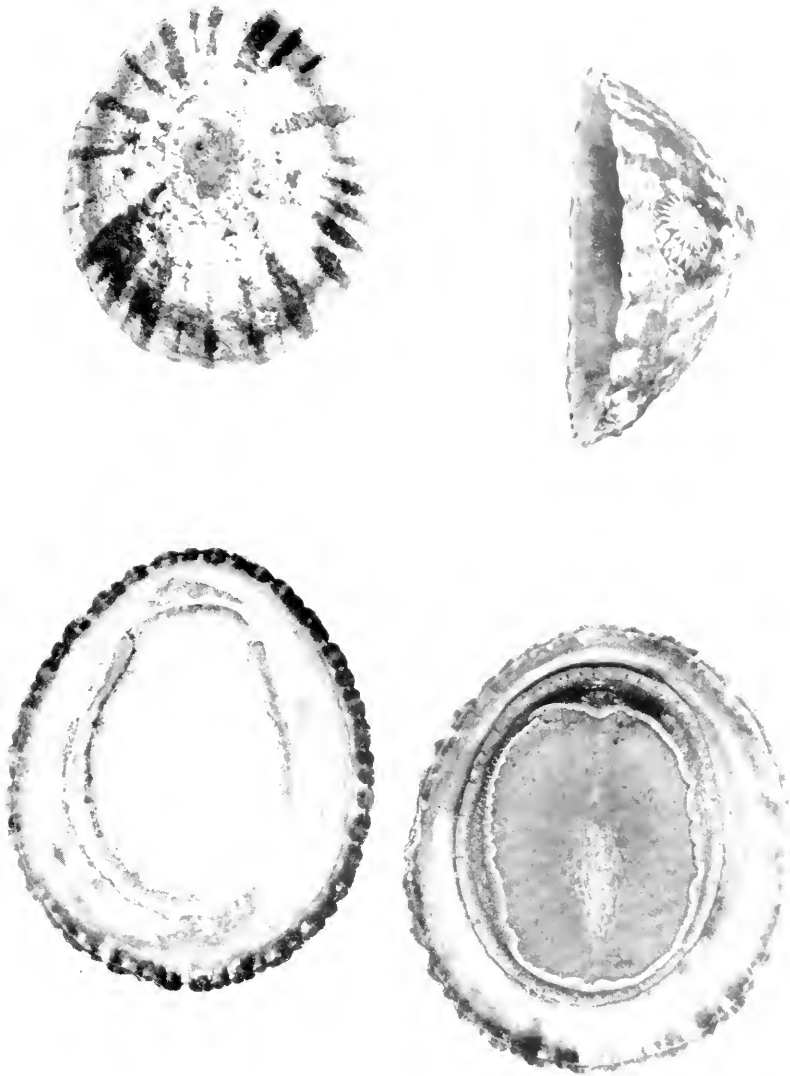
TYPE: This species was first described by Thomas Martyn, in 1784, from shells collected in the Straits of Magellan and deposited in his cabinet. The variety *magellanica* was established by Gmelin on specimens from the Straits of Magellan, who also described a variation of *magellanica* under the name *areolata*, now regarded as merely a synonym. His types are deposited at Upsala.

Various forms of the variety *magellanica* have been described under different names, i. e., *Patella atramentosa*, *P. venosa* and *P. chilensis* by Lovell Reeve, whose types are deposited in the British Museum, and *Patella meridionalis*, *P. metallica*, *P. pupillata* and *P. tineta* by M. Rochebrune and Mabilie from shells collected by the French government's Mission Scientifique du Cap Horn, 1882-83, and deposited in the Paris Museum.

MATERIAL EXAMINED: Eighteen specimens taken on the shores of Clotilde Island, Chiloe Archipelago, Chile, February 12, 1935.

DISTRIBUTION: This species and its variety are known from the littoral zone of the Magellanic Province.

TECHNICAL DESCRIPTION: One of the largest shells in the present series has a long diameter of 50 millimeters, a short diameter of 40 millimeters and an altitude of 6 millimeters, while



Nacella acnea Martyn variety *magellanica* Gmelin, $\times 1.2$, dorsal and profile views of shell, above, and ventral views of shell without and with the animal, below, from Clotilde Island, Chiloe Archipelago, Chile.

one of the smallest shells measures: long diameter, 15 millimeters; short diameter, 13 millimeters, and altitude, 6 millimeters.

Shell solid, wide-oval, approaching subcircular, elevated, subconical, apex erect, slightly posterior to the anterior third, surface variously sculptured by thirty to forty moderately strong, radiating ribs, of somewhat irregular width, which vary from strongly ribbed, closely scale-grained to nearly smooth; the apical area frequently eroded in large specimens with ribs remaining only on the outer half to two-thirds of the surface. Colour ashen-brown with several wide concentric dark brown zones, or uniformly brownish ashen, radiately streaked with deep brown alternating with ashen, or with oblique brown streaks. Interior opalescent milky white with varying lilac to rosy tints to dark brownish gray with opalescent lilac tones. Muscle-scar pearly gray to snowy white. Margin crenulate, brownish or alternately maculated ashen and brownish, the darker spots corresponding to the dark ribs of the exterior surface.

REFERENCES: *Patella aenea*, MARTYN, THOMAS, Universal Conchologist, 1784, vol. I, p. 17.—REEVE, L., Conch. Icon., 1854, f. 9.—SMITH, E. A., Philosoph. Trans. Roy. Soc. London, 1879, vol. CLXVIII, p. 179.

Patella gaudichaudi, DE BLAINVILLE, H. M. D., Dict. Sci. Nat. Paris, 1825, t. XXXVIII, p. 93.

Nacella aenea, PILSBRY, H. A., Man. Conch., 1891, vol. XIII, pl. 15, figs. 5, 6, pl. 45, figs. 22-23.

Patella aenea variety *magellanica*, GMELIN, J. F., Syst. Nat., ed. XIII, p. 3703.—REEVE, L., Conch. Icon., 1854, fig. 19.—PILSBRY, H. A., Man. Conch., 1891, vol. XIII, p. 119, pl. 44, figs. 9-17, pl. 43, figs. 1, 6.

Patinella magellanica, DALL, W. H., American Journ. Conch., 1871-72, vol. VII, p. 273, pl. 15, fig. 24 (soft parts and dentition).

Patella atramentosa, REEVE, L., Conch. Icon., 1854, fig. 41.

Patella venosa, REEVE, L., loc. cit., fig. 18.

Patella chilensis, REEVE, L., loc. cit., fig. 98.

Patella meridionalis, ROCHEBRUNE, DE, A. T., et MABILLE, J., Bull. Soc. Phil. Paris, 1885, ser. 7, t. IX, p. 109; Mission Scientif. du Cap Horn, Zool., 1891, t. VI, p. 94, pl. 5, fig. 4.

Patella metallica, ROCHEBRUNE, DE, A. T., et MABILLE, J., op. cit.,
p. 91, pl. 5, fig. 5.

Patella pupillata, ROCHEBRUNE, DE, A. T., et MABILLE, J., op. cit.,
p. 92, pl. 5, fig. 6.

Patella tincta, ROCHEBRUNE, DE, A. T., et MABILLE, J., op. cit.,
p. 93, pl. 5, fig. 7.

Genus: **HELCIONISCUS** Dall

Helcioniscus argentatus Sowerby

✓

Plate 117

TYPE: The type was collected by Captain Beechey's voyage in H. M. S. "Blossom" at Tahiti, according to Dr. H. A. Pilsbry's careful analysis; he points out that the published locality of "Chile" is an error, due to an unfortunate mixing of the "Blossom's" shells. The type is deposited in the British Museum of Natural History.

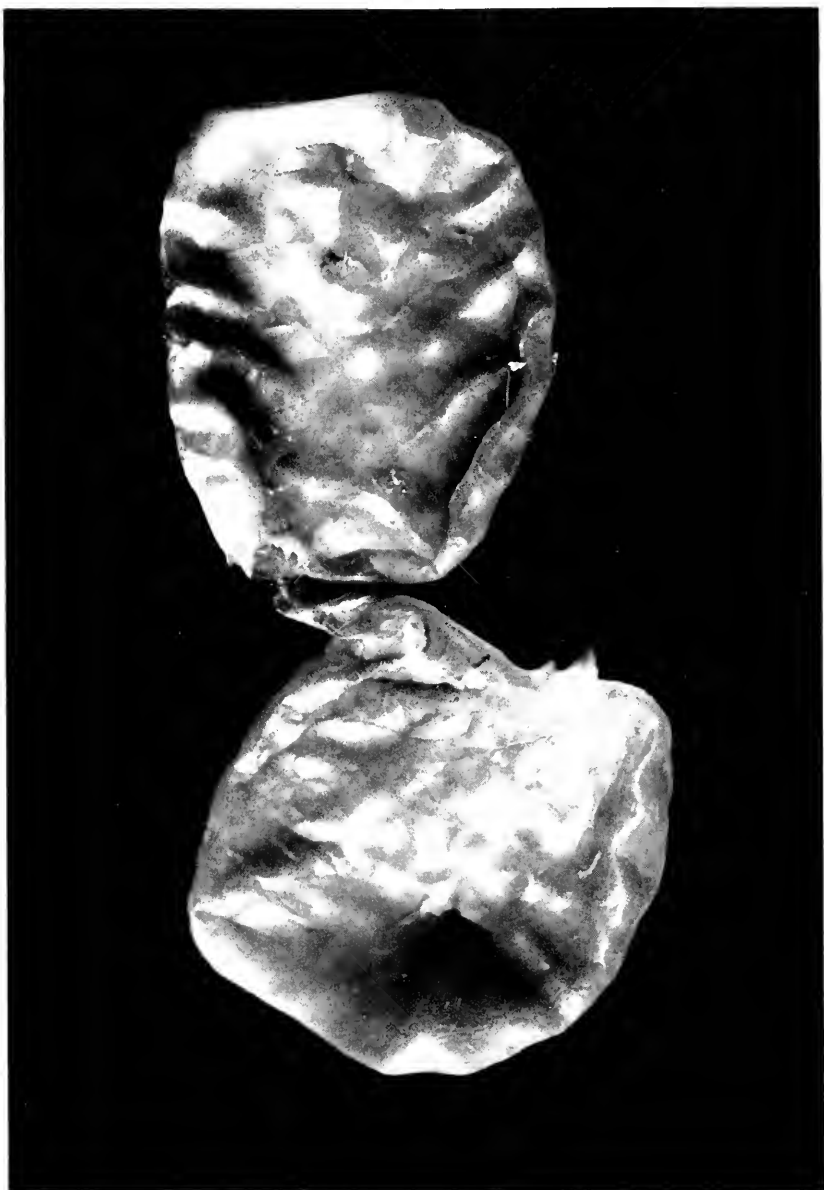
DISTRIBUTION: Hawaiian Islands, Society Islands, Littoral.

MATERIAL EXAMINED: Two specimens, taken on the rocks, at Hilo, Hawaii, December, 1928, "Ara" World Cruise.

TECHNICAL DESCRIPTION: Shell large, 88 millimeters long diameter, 77 millimeters short diameter; height, 31 millimeters; the apex in this specimen occurs 40 millimeters from the anterior margin; shell thick, wide, oval, slightly narrower on the anterior third than on the posterior portion, of a conical-dome shape with convex slopes, apex subcentral, being very slightly anterior in young specimens; surface sculptured with numerous small, close-set, unequal, radiating riblets, 56 in the present specimen, which render the margin weakly crenulate and are reflected as fine, radiating under lines on the inner surface. The colour is chestnut brown with coppery tones on the outer surface; the interior has a large, pure white central callus, bordered by a dull whitish zone around the muscle impression, beyond which the wide circumferal zone is shining opalescent pale golden or silvery with delicate tones of lilac-rose blue or pale green, the marginal line being narrowly chestnut brown.



Helcioniscus argentatus G. Sowerby, $\times 1$, from Hilo, Hawaii.



Two units of the nidamental capsule of *Megalatractus aruanus* (Linné), $\times 5$, from Falcon Island, Palm Islands, Queensland.

- REFERENCES: *Patella argentata*, SOWERBY, G., in Captain Beechey's Voy. H. M. S. "Blossom," Zool. Mollusca, 1839, p. 148, pl. 39, fig. 7.
- Patella cuprea*, REEVE, L., Conch. Icon., Oct., 1854, fig. 15; also errata to *Patella* in index, Conch. Icon.
- Patella talcosa*, GOULD, A., in Wilkes, C., U. S. Explor. Exped., Mollusca, 1852, vol. XII, p. 334, atlas XII, fig. 452.
- Helcioniscus argentata*, PILSBRY, H. A., Man. Conch., 1891, vol. XIII, p. 127, pl. 18, figs. 29-30, pl. 65, fig. 93.

Superfamily: **RHACHIGLOSSA**

Family: **TURBINELLIDAE**

Genus: **MEGALATRACTUS** Fischer

Megalatractus aruanus (Linné)

✓

Plate 118

TYPE: Linné confused an American and a New Guinea species under his *Murex aruanus*. Gmelin (1788) restricted the name for the New Guinea species. This is deposited in the "Mus. Lud. Ulr. 641, No. 3221."

DISTRIBUTION: Dr. Hedley gives the Australian range of this species as being from the Dampier Archipelago in the northwest continuously to the Great Barrier Reef in the northeast. It is also known from New Guinea and Amboina.

MATERIAL EXAMINED: An egg-case, apparently of this species, collected at Falcon Island, Palm Islands, Queensland, October 7, 1931.

REMARKS: The nidamental capsule, consisting of thirteen parts, united at the ventral or concave side, is arranged with each compartment fitting into its predecessor and receiving its successor saucer-wise. The outer surface of each compartment is marked by seven to nine ridge-like elevations, separated by concave depressions, all of which radiate approximately from the point of attachment, toward the margin, giving the latter a coarsely crenulate aspect. The integument is a tough leathery

substance, possessing considerable elasticity, even in the spirit-preserved condition. The circumferal margin is coarsely crenulate, the internal cavity being evident. The largest embryos within a compartment are less than the size of an ordinary pin-head. Several embryos are present within each unit of the capsule, indicating that an egg-case may contain over a hundred young, per each dozen compartments.

The nepionic shell of *M. aruanus* has an unusually interesting history, having been described as the type of a new genus and species.

Large specimens of this giant whelk were favorably known to the Australian aborigines, who used them as water carriers, a fact which accounts for the shell sometimes being found far inland. The meat was also esteemed as a native food and is popularly considered to be rich in iodine.

An excellent photograph of a large representative of the species is given by Saville Kent, while the nepionic shell has been well figured by Tryon. The anatomy of the adult animal has been presented by Kesteven, in comparison with that of *M. maximus* Linné, with excellent illustrations. He also gives a discussion of the larval stages. The young stages are ably discussed by Hedley, also the nomenclature.

The American knobbed whelk, *Fulgur carica* (Gmelin), is well known to deposit an egg-case of general structure similar to the present species, but the egg-chain is more than twice as long as the shell of the parent. Coiled or loosely spiralled egg-chains, having a linear length of from 18 inches to two feet, are not infrequently found on the shores of Long Island Sound. As the Australian species, *M. aruanus*, is one of the most gigantic gastropods, known to attain a length of 22 to 24 inches and a breadth of 9.5 inches, it seems not improbable that the egg-capsule figured by Dr. Hedley, also the present specimen, is in reality each but a small fragment of an entire egg-chain. This should prove an interesting item for field investigation.

REFERENCES: *Murex aruanus*, LINNÉ, C., Syst. Nat., 1758, vol. I, p. 753, entry 484.—GMELIN, J. F., Syst. Nat., ed. 13, 1788, p. 3546, entry 71.

Fusus proboscidiiformis, KENT, SAVILLE, The Great Barrier Reef of Australia, 93, p. 64, pl. 42.



Cymbium flammenum Bolten, nepionic shells, $\times 2.5$, extracted from nidamental capsules, taken at Southport, Australia.

Megalatractus aruanus, HEDLEY, C., Proc. Linn. Soc. N. S. W., 1900, vol. XXV, p. 99; also p. 509, pl. 25, fig. 18 (nomenclature, eggs).—KESTEVEN, H. L., Mem. Sydney, Austral. Mus., 1899-1907 ("Thetis" Exped.), vol. IV, pt. 8, May 2, 1904, p. 417, pl. 39, figs. 1, 3 and 5, pl. 40, fig. 2, pl. 41, fig. 2, pl. 42, figs. 1, 2, text fig. 119, 120 (protoconch); Proc. Linn. Soc. N. S. W., 1905, vol. XXX, p. 326 (additional study on the young stages).—HEDLEY, C., Proc. Sec. D, Rept. Austral. Assoc. Adv. Sci., Brisbane, 1909, vol. XII, p. 365.—THORPE, W. W., Austral. Mus. Mag. Sydney, July-Sept., 1928, vol. III, No. 7, p. 236, fig., "photo by Whitelegge," same page.

Family: VOLUTIDAE

Genus: CYMBIUM de Montfort

Cymbium flammeum Bolten

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Plate 119

TYPE: Bolten's entry (1798, p. 151) cites: "1899—3 *C. flammeum*. Die bunte Tepel -Bake. Martini 3 t. 74, f. 780, 4 st." The Bolten collection, originally in Hamburg, was sold in parts, after Dr. Bolten's death.

DISTRIBUTION: This species leads a lazy life in the little pools floored with sand among the coral reefs. In such a pool the present series of nepionic shells were found. It is common on the entire coast of Queensland, having been recorded from Moreton Bay, Masthead Island, Dunk Island, Cape Grafton, Cape Bedford, Torres Strait and the Gulf of Carpenteria (Hedley). It is also found in the Philippines (Cuming, Reeve) and New Guinea. It was not taken by the "Siboga" during her extensive explorations in the Dutch East Indies.

MATERIAL EXAMINED: A large mass of nidamental capsules, containing the nepionic shells, apparently of *Cymbium flammeum* Bolten were taken at Southport, Australia, September 23, 1931, by the "Alva."

REMARKS: The young shells are unequally developed throughout the mass and are nearly ready to escape from the capsules.

The present clutch of eggs was attached to a coral basally and has the shape of truncate cone, about 16 inches long, 10 inches basal diameter and 6.5 inches diameter distally. The individual capsules, which are conical, have the apex rounded, free, directed inwards, the bases external, connected with one another but incompletely, so that the slit-like apertures occur irregularly between them. The alcohol-preserved capsules are undoubtedly shrunk and are tough, cartilaginous; when dried, they become like dried mucilage, ranging from one and three-eighths to seven-eighths inches long. The capsules are arranged longitudinally and a little obliquely in the mass, in regular rows, so that the outer end of each capsule is exposed. When sectioned transversely, the capsule walls appear to be formed by agglutination of adjacent sidewalls, somewhat after the manner of cells in a honey-bee comb. Each capsule has a ridged thickening on the lower side, which terminates outwardly as an acute, thorn-like process.

There is never but one embryo per capsule; about one hundred and twenty to one hundred and thirty are present in this mass. All the embryos have the apices turned outward and their anterior canals toward the center. A typical large specimen from the basal portion of the mass has the shell measuring 36 millimeters altitude and 16.1 millimeters median diameter, with the aperture 25 millimeters long and 9 millimeters greatest width.

The shell has four and one-half whorls and has not yet developed the ornamental spines or teeth that coronate the adult shell, except for two or three small nodules on the outermost whorl. The columella bears three plaits, well developed, the outer one being the largest. The distal end of the shell has the characteristic notch. The aperture is wide, the outer lip thin, fragile. Though unfortunately preserved in alcohol with the usual injury to color resultant, the shells retain the distinctive creamy to tawny yellow on the first three and a half to four whorls, the outer half-whorl being maculated with a conspicuous pattern in chestnut brown similar to that shown in Sowerby's figure of *Melo diadema* and of *Melo mucronatus* Sowerby. The type of the latter is from Moreton Bay, New Holland.

The slug is black, large, when expanded enveloping a part of the shell. When alive the slug weighs from two to three pounds.

The adult shell may attain a length of 18 inches and a width of 12 inches and is well known as one of the most valuable mol-

lusk to the primitive peoples, who used the slug as food, usually wrapped in banana leaves and baked on hot stones. The shell was used variously as a cooking utensil, dish, spoon, or a boat bailer, for making a shield in primitive armour or as a handle to a womerah (weapon). Dr. Hedley gives a list of the various native names by which the species is known to the aborigines of Australia (1909).

The first description of the egg-mass and neanic shell of this large mollusk was given by Kesteven (1903) on material presumably obtained near Sydney. Bancroft (1908) described a large egg-mass from material he found on Dunk Island. In 1910 J. Edgar Smith published additional remarks on more material from the same island, which he obtained from Mr. A. J. Jukes-Brown, who had it, together with notes and a photograph (apparently unpublished), from Mr. Bancroft. This egg-mass was approximately the same size and shape of the one secured by the "Alva" at Southport, Queensland.

The species is ovoviviparous.

Dr. John D. MacDonald, R. N. (1879), records that specimens of *Cymbium flammeum* from Sharks Bay, W. Australia, were found to be infested in the respiratory siphon with a trematode, *Aspidogaster macdonaldi* Monticelli.

REFERENCES: *Cymbium flammeum*, BOLTEN, J. F., Museum Boltenianum, 1798, (2), p. 151, cited for Martini Conch. Cab., 1777, Bd. III, p. 59, pl. 74, fig. 780.—HEDLEY, C., Proc. Linn. Soc. N. S. W., 1909, vol. XXXIV, p. 452 (first use of Bolten's name); Proc. of Sect. D, Rept. 12th Meet. Austral. Assoc. Adv. Sci., Brisbane, 1909, (1910), p. 342.

Voluta diadema, LAMARCK, J. B., Ann. des Mus. Paris, 1811, t. XVII, p. 57.

Voluta ducalis, LAMARCK, J. B., Anim. sans Vert., 1844, t. X, p. 377.

Melo diadema, REEVE, L., Conch., Icon., 1862, vol. 14, pl. 14.—TRYON, G. W., Man. Conch., 1882, vol. IV, p. 81, pl. 23, figs. 22-28.

Cymbium aethiopicum, BANCROFT, E. J., The Confessions of a Beachcomber, 1908, p. 145 (describes egg-case and larvae).

Melo mucronatus, BRODERIP, W. J., Spec. Conchyl., 1830, vol. I, pt. 1, p. 7.

Melo ducalis, TRYON, op. cit., p. 81.

Melo broderipii, GRAY, J. E., in Griffith's edition of Cuvier, Règne Anim. Moll., pl. 24, 1833.

Cymbium broderipii, GRAY, J. E., Brit. Mus. Cat. Moll., 1855, p. 7.—REEVE, L., Conch. Icon, 1860-62, vol. XCIII, pl. 5 of *Cymbium* and opposite page.

Cymbium ducale, REEVE, L., op. cit., pls. 7 and 8.

Melo georginae, GRAY, J. E., op. cit., Cuvier, Moll. pl. 34.

Cymbium georginae, GRAY, J. E., Brit. Mus. Cat. Moll., 1855, p. 7.—REEVE, Conch. Icon., 1862, vol. XIII, pls. 11, 12, and 13.

Cymbium diadema, HEDLEY, C., Proc. Linn. Soc. N. S. W., 1907, vol. XXXII, p. 484.

Melo diadema, KESTEVEN, H. L., Proc. Linn. Soc. N. S. W., 1903, vol. XXVIII, p. 442 (neanic shell).

Melo egg-capsules, SMITH, E. A., Proc. Malacol. Soc. London, 1911, vol. IX, p. 4.

Superfamily: TAENIOGLOSSA

Family: SEPTIDAE

Genus: CYMATIUM Bolten

Cymatium nodiferum (Lamarck)

1

Plate 120

TYPE: This species, first figured by Lister (t. 960, f. 13), was described by Lamarck, from specimens collected in the Mediterranean Sea and deposited in the Jardin des Plantes.

DISTRIBUTION: This "triton" has its center of distribution in the Mediterranean Sea, where it is known on both the European and African coasts, also in the Adriatic and Aegean Seas; westward it is known in the North Atlantic Ocean to the Azores, along the coasts of the Hispanic Peninsula, in the Bay of Biscay to Brest and northward on the southern coast of England, where it has been taken along the Guernsey coast, the Caskets and Channel Isles.



Cymatium nodiferum (Lamarck), $\times 0.75$, from Casa Blanca, Morocco,
Mediterranean Sea.

MATERIAL EXAMINED: One very fine shell with the animal within, taken at Casa Blanca, Morocco, Mediterranean Sea, July 1, 1933, by the "Alva."

REMARKS: The true Triton's trumpet of Grecian mythology is believed to be *Murex tritonis* Linné. The present shell, *Cymatium nodiferum* (Lamarck), is said by Verany to be the one in use at Nice as a trumpet or horn by the fishermen and peasants, a hole near the apex of the shell being all that is required to convert it into a horn capable of producing a distinctive noise. Verany states that it is frequently used for the old-fashioned *charivari*, a noisy serenade given to celebrate the marriage of ill-assorted couples.

This species of mollusk is frequently used for food in the Mediterranean countries, being equally prized by Portuguese, Sicilian, Algerian and Grecian peoples, many of whom eat it raw. The meat is somewhat tough, in flavour not unlike that of scallops. It is considered by modern dietitians to be rich in iodine and mineral salts.

Cymatium nodiferum (Lamarck) is conspicuous among the living molluscan exhibits in most of the Aquaria along the Mediterranean.

The shell is covered by a thin, yellowish brown epidermis, beneath which the colour pattern of the shell is seen to be a pale flesh-tinged whitish, variegated by irregular spots and narrowed stripes of chestnut brown. The aperture is porcellanous white. It is the living snail with its graceful body of vermilion maculated with diffused patches of reddish brown, the mantle white maculated, the tentacles marked with two black lines, the sole of the foot vivid orange, the operculum amber, which fascinates the observer, as the giant snail achieves a graceful mobility despite the thick, heavy shell.

TECHNICAL DESCRIPTION: The shell is oblong-conic, large, thick, heavy, and opaque; the aperture and inner lip somewhat porcellanous; the exterior somewhat glossy, frequently eroded and encrusted with foreign objects. The spire is elongated, whorls nine, tumid, compressed upwards, the last one occupying about three-fifths of the shell; suture moderate. The external surface is sculptured with four varices, the largest one being immediately behind the lip on the body whorl, the others being similarly placed on each of the body whorls; these ridges are growth marks. The entire surface is sculptured by prominent ridges, which are

coarsely nodose; between these ridges there are finer, intermediate, spiral striae, also microscopic spiral lines. The aperture is about one-half as long as the spire, a wide oval, abruptly acute-angled at the upper and lower ends; the canal is wide, deep, terminating externally in a shallow notch, marginally thickened; the outer lip is semi-circular, sloping inward, widely fluted, marginally crenulate, consisting of about fifteen narrowed areas alternating with sixteen wider spaces, the narrowed groove-like areas being chestnut brown; the inner lip is porcellanous, thicker on the outside of the canal; the pillar is broad, transversely furrowed with numerous plaits which increase in strength, from lowermost to uppermost, which is separated by a smooth space from the upper angle of the aperture. The operculum is obliquely oblong-ovate, thick, of horn-colour, with growth lines indicated by the irregular imbrication of the deposit.

REFERENCES: LISTER, M., Conch., t. 960, fig. 13.

Triton nodiferum, LAMARCK, J. B., Anim. sans Vert., 1822, t. IX, p. 178, No. 2.—REEVE, L., Conch. Icon. *Triton* No. 9, t. 3, f. 9.

Triton nodiferus, MARTINI, F. H. W., und CHEMNITZ, J. H., Syst. Conch. Cabinet, 1878, Moll Gastr. *Purpuracea* Bd. II, p. 177, pl. 51.—DAUTZENBERG, P., et FISCHER, H., Res. Campagnes Sci. du Prince de Monaco, 1906, Fasc. XXXII, Mollusques, p. 32.

Class: PELECYPODA

Order: FILIBRANCHIA

Family: ARCIDAE

Genus: ARCA Linné

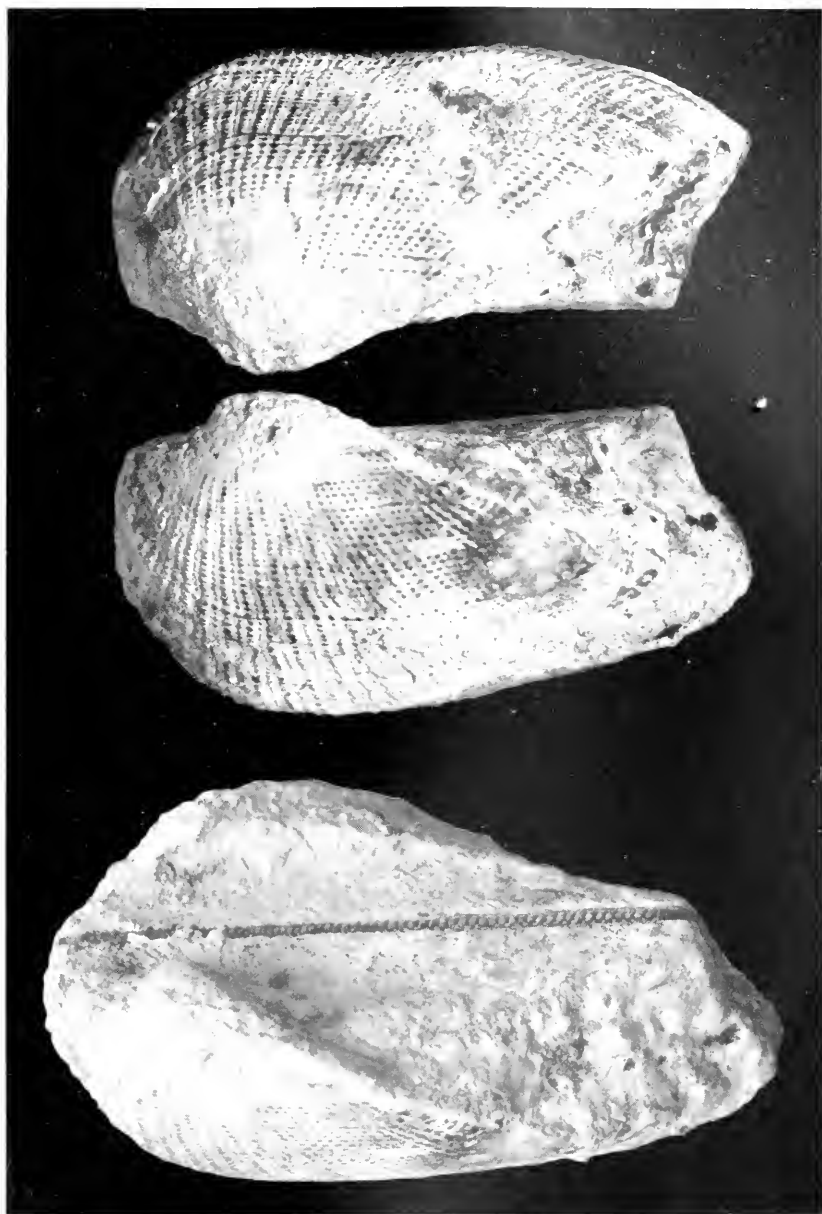
Subgenus: *Navicula* de Blainville

Arca (*Navicula*) *avellana* Lamarck

✓

Plates 121 and 122

TYPE: Lamarck's type of *avellana* came from the Islands of Saint Peter and Saint Francis, on the south coast of Australia, while his type of *retusa* came from Timor. Both of these types are deposited in the Paris Museum.



Arca (Nucula) arellana Lamarck, taken in coral, Teviatea Reef, Raiatea Island, Society Islands; upper shells, $\times 1$, lower figure, $\times 1.15$.



Arca (Navicula) avellana Lamarck, interior of valves, collected in coral, Teviatea Reef, Raiatea Island, Society Islands; $\times 1$.

DISTRIBUTION: This species, close congener of the West Indian *Arca imbricata* Brugiere, is widely distributed in the littoral zone of the Indo-Pacific, having been reliably reported from the Gulf of Suez and Red Sea southward to South Africa and eastward in the Mascarenes, through the Gulf of Manaar, Mergui Archipelago, Dutch East Indies, Celebes, Kei Islands, northward to Japan, down to Borneo, New Caledonia, Australia and in the Society Islands.

MATERIAL EXAMINED: Two specimens, taken in coral, Teviatea Reef, Raiatea Island, Society Islands, August 21, 1931.

TECHNICAL DESCRIPTION: The two Society Island specimens agree well with M. Lamy's (1904) remarks and illustrations of Lamarck's *Arca avellana*. The present writer concurs in Mr. Prashad's separation of *A. avellana* from the closely allied *Arca imbricata* Brugiere. Mr. Prashad has published an excellent synonymy of the Indo-Pacific species.

The Raiatea Island specimens are figured in plates 121 and 122.

The shell is approximately oblong, ark-shape, the hinge line being twice as long as the median transverse diameter of the shell, the anterior end rounded, moderately tumid; the ventral margin is moderately gaping, its contour having a shallow concavity; the posterior margin is attenuate, rather obliquely truncate. The umbones are well separated, elevated, as shown in the plates 121 and 122, for a distance equal to one-fourth of the total transverse diameter of the shell at this point. There is a pronounced blunt keel extending from the umbo diagonally to the posterior portion of the ventral margin. The dorsal surface of the shell has the anterior and median portion marked with continuous series of ridges, these ridges being regularly crossed transversely with moderately elevated striae. The posterior portion is also ridged, the ridges approaching the keel being bluntish. The interior of the shell is brownish cream with some bluish tinges anteriorly. The anterior muscle scar is narrowly oval, the posterior scar is the larger, more nearly circular. The hinge consists of a series of rather regular, small teeth, comb-like, interlocking with those alternating of the opposite valve.

REFERENCES: *Arca noae* variety, CHEMNITZ, J. H. (*partim*)
Conch. Cab., 1874, p. 183, pl. 54, fig. 532.

Arca avellana, LAMARCK, J. B., Anim. sans Vert., 1819, t. VI, p. 38.—LAMY, ED., Journ. Conchyliol., 1904, t. LII, p. 136, pl. 5, figs. 1, 2.—PRASHAD, B., Siboga-Expeditie Monogr. LIII-a, Lamellibranchiata exclusive of Pectenidae, pt. II, Pelecypoda, p. 32 (with exhaustive synonymy).

Family: ISOGNOMONIIDAE

Genus: ISOGNOMON Solander

Isognomon perna (Linné)

✓

Plates 123 and 124

TYPE: Linné's type is in the Museum Ludovicæ. He states: "*Habitat in Indiis.*" Lamarck's type of *I. sulcatus* is in the Paris Museum. Gould's type of *I. eremita*, taken by the United States Exploring Expedition at Carlshoff Island, Paumotu Archipelago, deposited in the Philadelphia Academy of Natural Sciences, is identical.

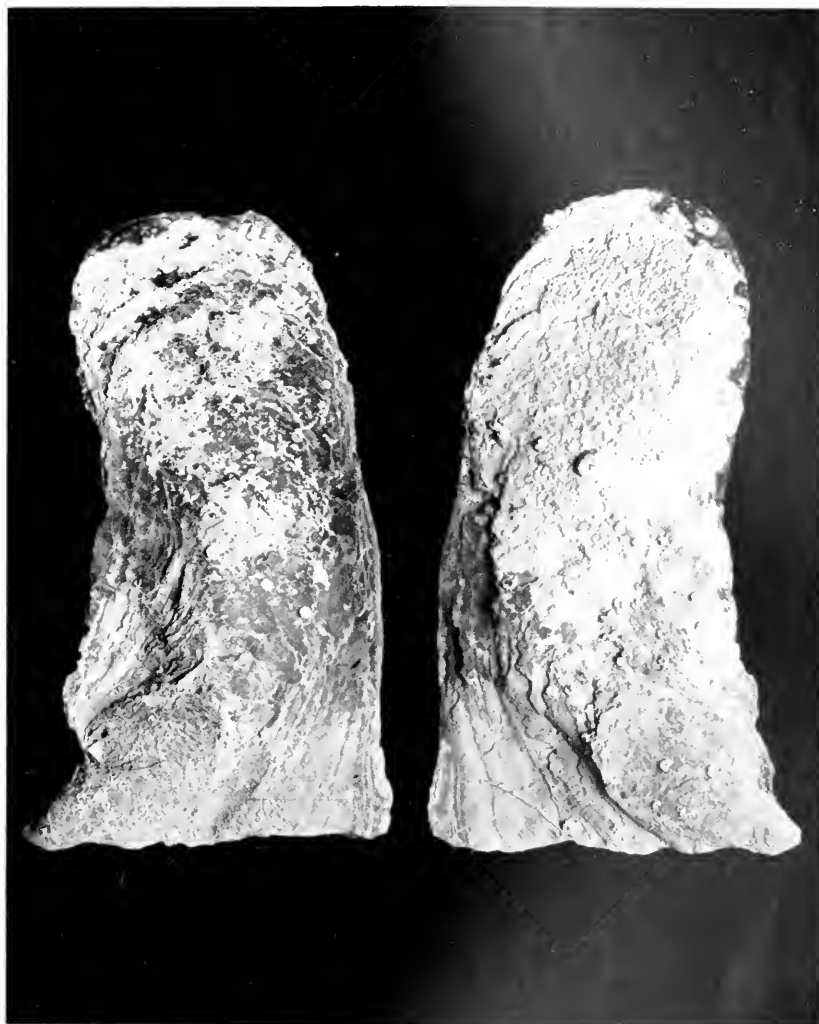
DISTRIBUTION: This species, first recorded by Lister in 1685, is widely distributed in the Indo-Pacific region. The species possesses a considerable degree of individual variation, which has given rise to a confusion of names, no less than eight being cited by Dr. Prashad, in his excellent synonymy of the species, based upon his study of the fine series of this shell secured by the "Siboga" in the Dutch East Indies.

MATERIAL EXAMINED: One specimen taken on the reef, Falcon Island, Palm Islands, Queensland, October 7, 1931.

REFERENCES: *Pecten leviter cavus*, etc., LISTER, M., Hist. Conch. libri quat., Londini, 1685, pl. 228, fig. 63.

Ostrea perna, LINNE, C., von Syst. Nat., ed. XII, 1767, p. 1149.

Isognomon perna, PELSENEER, P., Siboga-Expeditie, Monogr. LIII-A, 1911, Lamellibranchs, (Anatomy), p. 26, pl. 7, figs. 3-8.—PRASHAD, B., Siboga-Expeditie, Monogr. LIII-C, 1932, p. 85. (Excellent synonymy 1685-1932).



Isognomon perna (Linné), $\times 1.5$, from the reef, Falcon Island, Palm Islands, Queensland.



Isognomon perna (Linné), $\times 1.5$, from the reef, Falcon Island, Palm Islands, Queensland.



Pteria (Electroma) electrina Reeve, $\times 2.5$, exterior of specimen from Pago-Pago, Samoa.



Pteria (Electroma) electrina Reeve, $\times 2.5$, interior of specimen taken at Pago-Pago, Samoa.

Family: PTERIIDAE

Genus: PTERIA Scopoli

Subgenus: Electroma Stoliczka

Pteria (Electroma) electrina Reeve

✓

Plates 125 and 126

TYPE: Reeve's type was collected in the Moluccas and originally deposited in the Cuming Museum. The greater portion of the Cuming collection is in the British Museum of Natural History.

DISTRIBUTION: Moluccas (Reeve); Samoa (Boone).

MATERIAL EXAMINED: One small specimen, collected in Pago Pago, Samoa, September 2, 1931.

TECHNICAL DESCRIPTION: The shell is rich reddish amber, with the external surface marked by rays of lighter yellow-amber and slightly concentric tones of blackish green on the umbo. The interior has the proximal suboval area beneath the organism paved with an exquisite satiny white opalescent pearl, beyond which the orange-amber surface of the outer portion is glistening.

Shell obliquely oblong-subovate or subtrapezoidal, inequivalve, the right valve being less convex, flattish, the left valve moderately convex, with the greatest inflation from the umbo obliquely toward the posterior margin; the right valve less convex, flattish; the hinge margin is short, the greater portion of the dorsal margin obliquely receding to the posterior; the umbo is not very prominent in the present young specimen, but is figured as moderately so in larger shells by Reeve; the anterior auricle is small, beaklike. Faint concentric growth lines are present. The white dots described by Reeve as a part of the external colour pattern appear to be extraneous calcareous deposits when examined microscopically. The exquisite colouration of this species, enhanced by its translucency and extreme fragility and its distinctive oblong-subovate shape, readily distinguish it from other members of the genus.

The present specimen has a long diameter of 35 mm. Reeve has figured specimens with a long diameter of about 50 and 70 mm.

REFERENCES: *Avicula electrina*, REEVE, LOVELL, Conch. Icon., 1858, vol. X, *Avicula*, pl. 12, fig. 43-a-b, text opposite (March, 1857).

Genus: PINCTADA Roeding

Pinctada margaritifera (Linné) s. s. Jameson

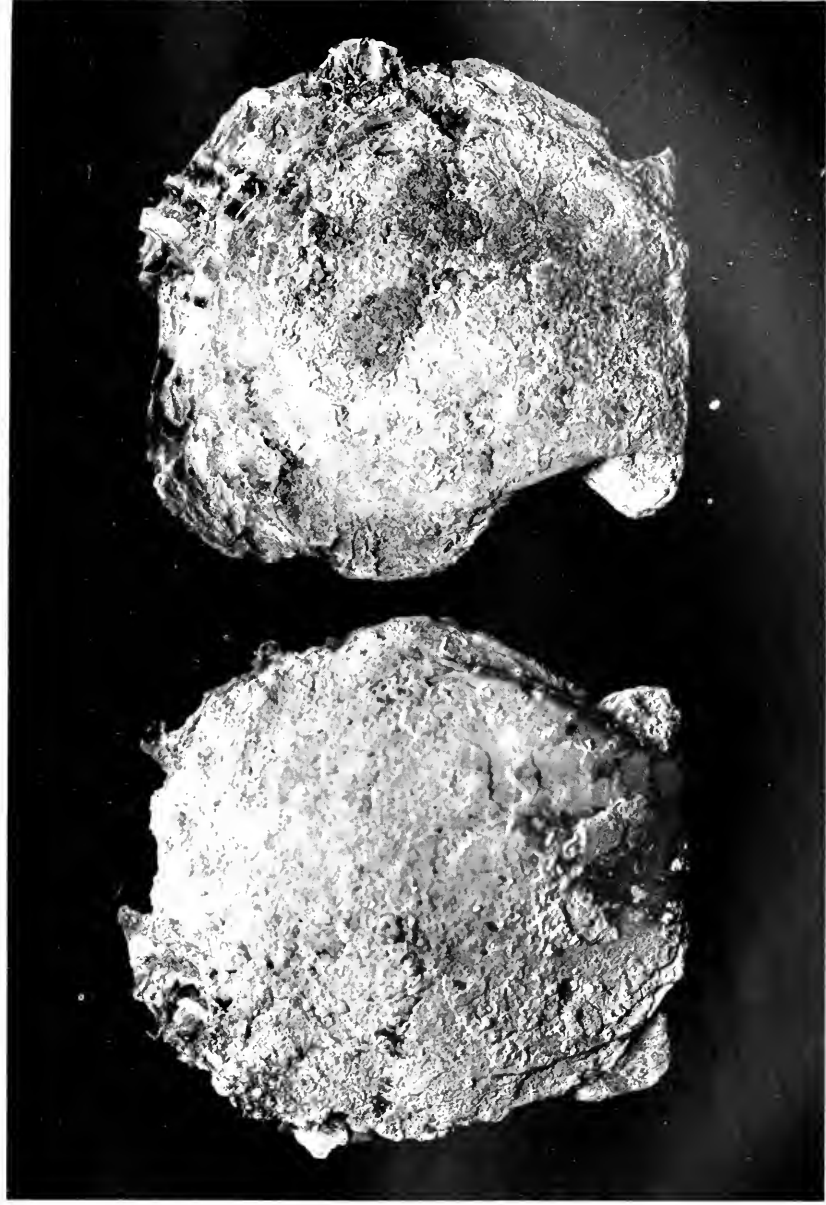
Plates 127 and 128

TYPE: Linné's type, deposited in the Museum of the Linnean Society of London, consists of a right valve of a typical East Indian specimen, believed to be from the Malay Archipelago, as it is a typical "Black-edged Banda" shell of trade. The other valve agrees with trade samples typical of the Red Sea. The specific locality of his types is unknown, Linné having stated: "*In utriusque indiae oceano.*"

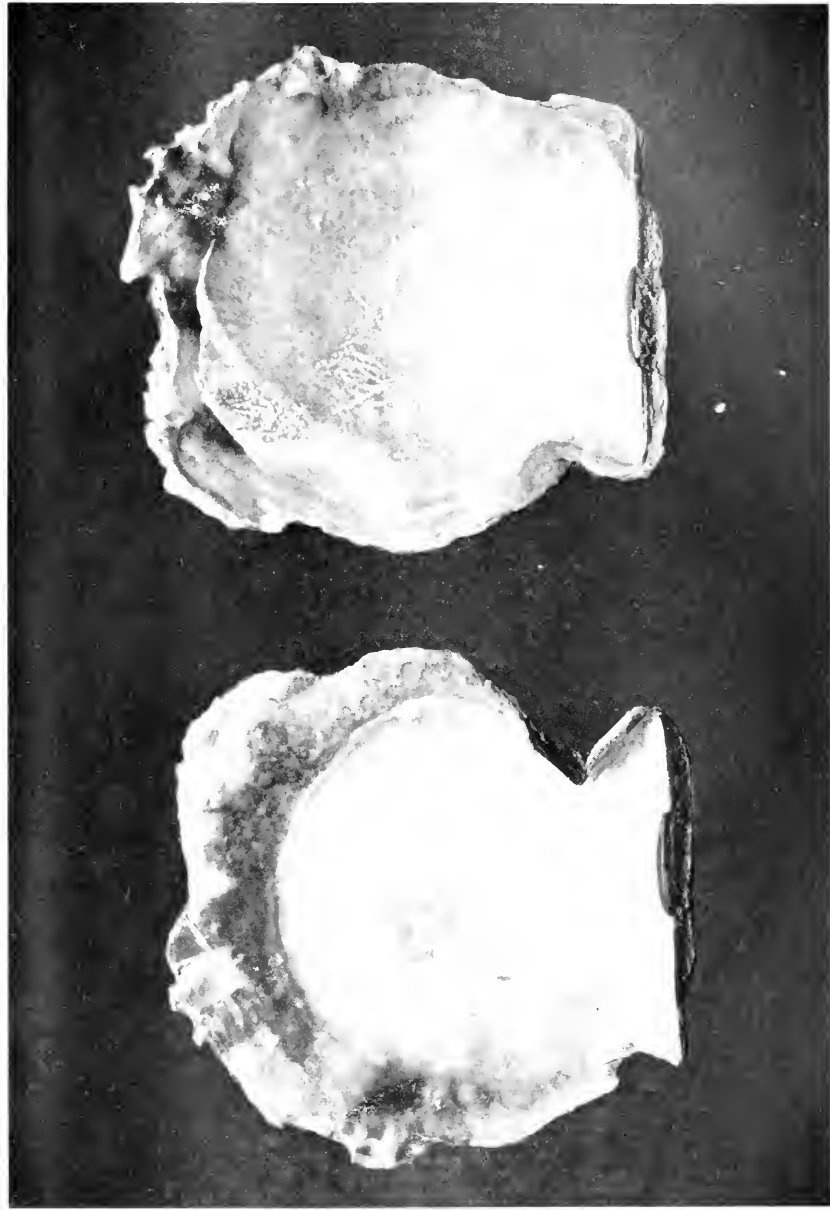
DISTRIBUTION: This species and its geographic races are very widely distributed in the Indo-Pacific and have been known to traders since the earliest times. The "Periplus" of the Erythraean Sea (60 A. D.), gives description of the pearl fisheries. Pliny (Nat. Hist. Bk. IX, chap. 54, Lemaire's edition), Athenaeus and Aelian remark upon the pearl fishers and the pearls, while in the Singhalese records the "Mahawanso" records Ceylon pearls among the gifts sent by King Vijaya of Ceylon to his Indian father-in-law about 540 to 550 B. C. and in 306 B. C., when King Devanampiyatissa sent an embassy to India, pearls were included in his gifts. Records of the first Royal Dutch Embassy received by the Emperor of China state that pearls were among the gifts the Emperor sent to the Leyden court. Fourteenth century Spanish and Portuguese navigators also brought back pearls. It is memorable that Queen Isabella of Spain sacrificed her pearls in behalf of Columbus' momentous voyage, designed to seek a shorter trade route to the fabled wealth of the East Indies. Sir Francis Drake is reputed to have brought back pearls and pearl shells to Royal Elizabeth.

Typical *Pinctada margaritifera* is found on the Australian coasts from about 29° S. on the west coast across the entire northern coast and down the eastern coast to Moreton Bay and vicinity, also on the coasts of New Guinea, New Britain, the Solomon Islands, the Philippine Archipelago, where it is especially abundant in the Sulu Sea, the Malay Archipelago, and also found in China, the Ceylon, the Andaman Isles and Maldive Archipelago.

Mr. Jameson distinguishes five geographical races in addition to the typical one, namely:



Pinctada margaritifera (Linné) s.s. Jameson, young, $\times 1$, from Falcon Island, Palm Islands, Queensland.



Pinctada margaritifera (Linné), s.s. Jameson, young, $\times 1$, from Falcon Island, Palm Islands, Queensland.

Variety *zanzibarensis* Jameson, found on the east coast of Africa, Zanzibar, Madagascar, Amirante Islands, Bazaruto Islands, Mauritius, Rodriguez, Seychelles.

Variety *persica* Jameson, found in the Persian Gulf, especially in the fisheries of the Island of Bahrun and known to the trade as "Bombay shell" because it is usually shipped via Bombay.

Variety *erythraensis* Jameson, from the Red Sea.

Variety *cumingi* (Reeve), the "black-edged shell" of eastern Polynesia, found in Tahiti, Gambier Archipelago, Lord Hood Island, Penrhyn Island and generally distributed in the islands of eastern Polynesia, Galapagos Islands and Payta, Peru.

Variety *mazatlanica* Hanley, the "Panama shell" of trade, known from the tropical and subtropical west coast of America from the Gulf of California, especially Mazatlan and Angel de la Guardia, also Panama and down to Payta, Peru.

The species *Pinctada galtsoffi* Bartsch, from the Hawaiian Islands, from the Pearl and Hermes Reefs and islands of Maui, Oahu and Hawaii, is merely a colour variety of *P. margaritifera* (Linné), long well known from this archipelago.

MATERIAL EXAMINED: One specimen, collected by the "Alva" at Falcon Island, Palm Islands, Queensland, October 7, 1931. A single young specimen, of the variety *cumingi* Reeve, was taken in coral, Teviatea reef, Raiatea Island, Society Islands, August 21, 1931.

DIAGNOSTIC CHARACTERS: The present species has long been confused with *Pinctada maxima* Jameson, which is also widely distributed in the Indo-Pacific. From Linné (1760) to Saville Kent (1893) the two species were confused under the Linnean name *margaritifera*. Kent restricted this name to the larger, more valuable, golden lip or silver-lip shell, but Pace, also Jameson, have established that Linné's type and descriptions refer to the "black lip" or "Black-edged Banda" shell.

The colouration of the true *margaritifera* is quite variable on the external surface of the valves, the ground colour ranging from pale yellowish brown, green, olivaceous, reddish gray to dark brown or black, distinctively marked with radial rows, consisting of cream or yellowish spots extending from the umbo to the margin. Variation in these spots ranges from their enlargement to fuse forming radiating bands, to complete obsolescence. The interior of the lip is similar in ground colour to the external surface

of the shell and usually shows broken lighter markings, corresponding to the distal end of the light radial bands of spots. The inner margin of the lip has a marginal band of brassy yellow, bronze or dark metallic green iridescence, while the pearly nacre is highly iridescent, frequently having a steely lustre.

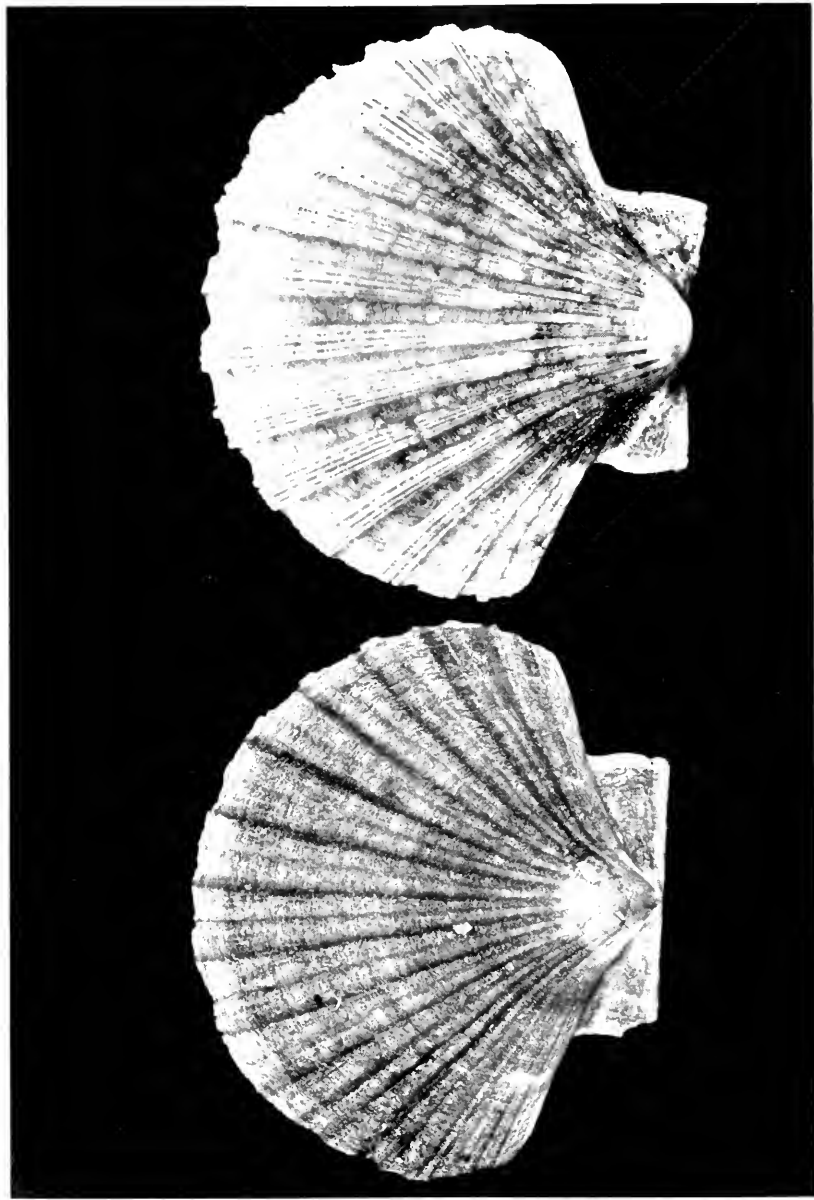
The shell is more convex than *P. maxima* and does not usually attain so great a size. *P. margaritifera* has a shorter hinge, the typical hinge margin being equal to about five-eighths of the pearly surface of the valve, measured from the anterior to the posterior margin. The anterior angle of the hinge is more distinctly separated from the shell than is the case in *maxima* and the posterior end of the hinge usually forms an obtuse angle where it meets the posterior margin. The posterior margin has no sinus. Ventral to the byssal notch the anterior margin projects much further forward than it does in *P. maxima*.

The lappet-like processes of the lip in the younger specimens are more closely crowded, more numerous, relatively longer and narrower than those of *maxima*, having the appearance of deep, U-shape scales.

As pointed out by Dr. Baini Prashad (Siboga, 1932, p. 99), the "Siboga" representatives of this species "vary a great deal in the shells, being orbicular, or as in the case of some shells from Station 144, very much elongated in the dorso-ventral direction and the outline becoming somewhat elongated-ovoid. The surface markings and the colouring are also very variable."

It is regrettable that the Smithsonian Institute has sponsored another synonym that must be added to the long and excellent synonymy of this species, *Pinctada margaritifera* (Linné), as given by Mr. Prashad, namely, the recently described *Pinctada galtsoffi* Bartsch, from the Pearl and Hermes Reefs, Hawaii.

Analysis of the very casual description of *Pinctada galtsoffi* Bartsch shows the type to be a larger than average size specimen of pearl oyster, but one possessing: (a) A hinge typical of *P. margaritifera*; (b) the general contour of the valve is one of the well known variations of the more usual orbicular shaped shell; (c) the colour, which the author describes, falls entirely within the range of variation long known for this species, except the notation: "The outer margin in the type is yellowish horn-coloured." The marginal borders of young paratypes, as described by Mr. Bartsch, is typical of *P. margaritifera*. The Galtsoff material was



Pecten jacobaeus (Linné), $\times 0.65$, from off Venice, Italy, in 35 fathoms.



Pecten jacobaeus (Linné), $\times 0.65$, from off Venice, Italy, in 35 fathoms.

for some time preserved in alcohol, which not improbably affected the original colour of the lip.

REFERENCES: *Concha margaritifera pleris*, LISTER, M., Hist. Conch., 1685, pl. 221, fig. 56.

Mytilus margaritiferus, LINNE, C. VON, Syst. Nat. ed. X, 1758, p. 209, p. 704.

Pinctada margaritifera, ROEDING, P. R., Mus. Boltenianum, 1798, p. 166.—PRASHAD, B., Siboga-Expeditie, Monogr. LIII-C, Livr. 118, 1932, Lamellibranchia: Pelecypoda (exclusive of Pectenidae), p. 98 (with excellent synonymy, 1685-1932).

Margaritifera margaritifera, JAMESON, H. L., Proc. Zool. Soc., London, 1901, p. 373.

Pinctada galtsoffi, BARTSCH, P., Proc. U. S. Nat. Mus., 1932 (June), vol. LXXIX, art. 12, p. 12, pls. 1, 2.

Family: PECTENIDAE

Pecten (Belon, 1553), Lamareck, 1799

Pecten jacobaeus (Linné)

✓

Plates 129 and 130

TYPE: Linné's type was obtained in the Mediterranean and is deposited in the mollusk collection of the Museum Ludovicae Ulricaе.

DISTRIBUTION: This species is known throughout the Mediterranean basin, where it is very abundant. It is also known in the fossil state from the Pliocene beds of Italy, Algeria and Greece and from the Pleistocene of Sicily.

MATERIAL EXAMINED: One very fine specimen, taken on mud bottom, in 20 fathoms depth, 35 miles off Venice, Italy, August 10, 1933.

DISCUSSION: The classical description of this species, its varieties, with exhaustive synonymy and discussion, clarifying the tedious confusion existent between this species and *Pecten maximus*, Linné, presented by Messieurs E. Bucquoy, P. Dautzenberg et H. Fischer (1889), is the standard reference for these species.

The specimen from Casa Blanca has a maximum transverse width of 109 millimeters and a length of 92 millimeters. There are sixteen elevated, striate rays on each valve.

REFERENCES: *Ostrea jacobaea*, LINNE, C. VON, Syst. Nat. 1758, ed. X, p. 696.

Pecten jacobaeus, BUCQUOY, E., Dautzenberg, P. et DOLFUSS, G., Mollusques du Rousillon, 1889, t. II, p. 62, pl. 12, figs. 1, 2, adult, pl. 13, figs. 1, 2, 3, 4, 6 and 7, juvenile.—DAUTZENBERG, P. et FISCHER, H., Res. Campagnes Sci. du Prince de Monaco, 1906, Fasc. 32, XXXII, Mollusques, p. 71.

Pecten zealandiae Gray

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Plates 131 and 132

TYPE: This was first taken in New Zealand and deposited in the collection of Hugh Cuming's Museum. The greater part of the Cuming mollusk collection is in the British Museum of Natural History.

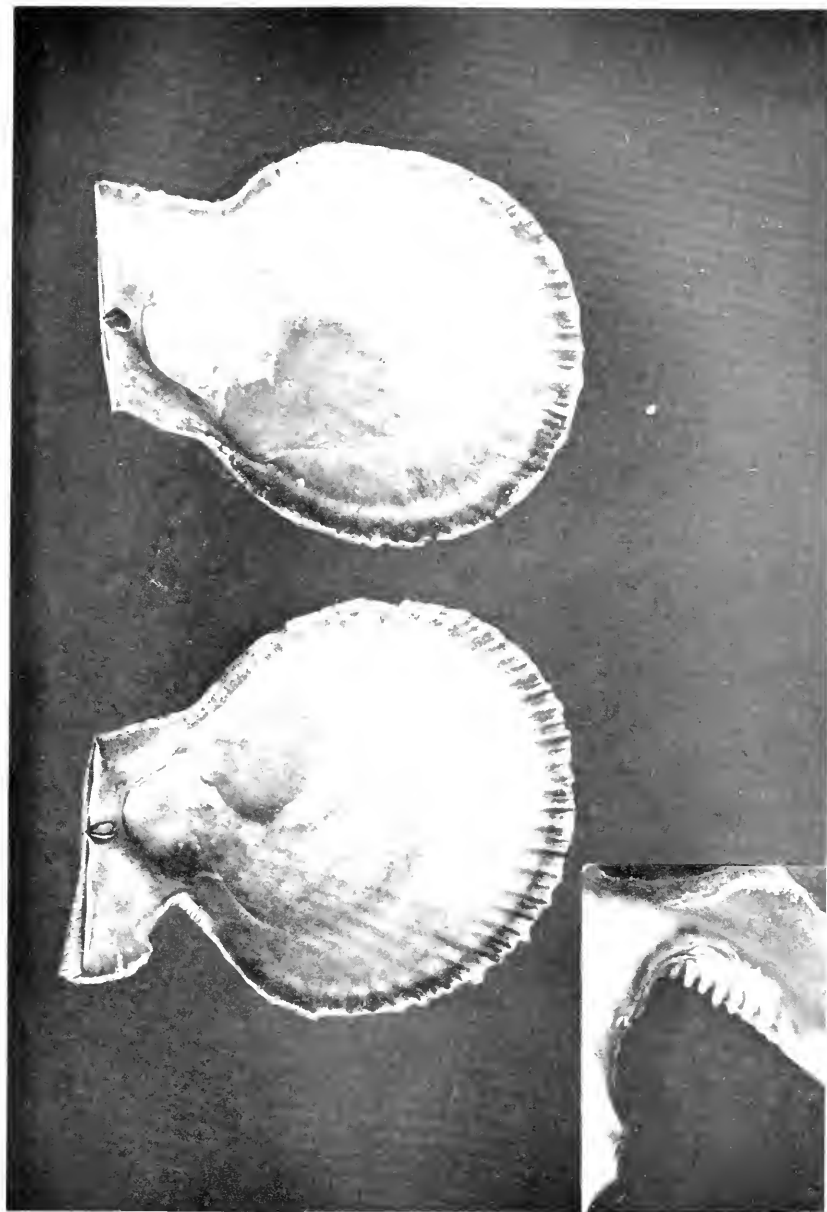
DISTRIBUTION: New Zealand (Gray, Reeve) ; Samoa (Boone).

MATERIAL EXAMINED: One specimen, taken at Pago-Pago, Samoa, September 2, 1931.

TECHNICAL DESCRIPTION: The single specimen taken by the "Alva" is an exquisite violaceous with reddish tones, the scales being lighter reddish-lavender proximally, fading into cream distally. The shell is subtriangulate-ovate, equilateral, nearly equi-valve, with the auricles decidedly unequal, the right one being much the larger and bearing about five ridges; the outer margin of this auricle is bent over upon the opposed valve. The external surface of the shell is only moderately inflated, marked with thirty-two close-set, radiate costae, each rib bearing in serial arrangement elevated scales or rugosities, the free outer margin of which varies from rounded to pointed. These costae convergent on the umbo of a smallish specimen, tend to give the shell a distinctive, plicated aspect, which in a larger specimen is less pronounced, the umbonal portion of the costae being much worn down. The



Pecten zealandiae Gray, $\times 1.5$, from Pago-Pago, Samoa.



Pecten zealandiae Gray, $\times 1.5$, from Pago-Pago, Samoa; inset, enlargement of the inner margin of the right side of the right valve, showing the seven teeth.



Spondylus nicobaricus Chemnitz, $\times 1$, from the reef, Falcon Island, Palm Islands, Queensland; showing the convex upper valve and profile of the hinge area of the lower valve.

intercostal area is marked on the outer two-fifths of each of the rays by a distinctive low ridge, unornamented, linear, which becomes less distinct, or obsolete, toward the umbonal region.

INTERIOR OF VALVE: The right valve bears seven teeth or ridges, separated from one another by a space of width and depth equivalent to that of one ridge; these being arranged in close series, on the inner margin of the right side of the valve, along the curve immediately below the auricle. The internal margin of the valve is exquisitely crenulate, repeating in light and dark shades of lavender-reddish-rose a maculated pattern banding the outer margin, followed on the inner side by a wider band of deep purple, which is replaced by a lilac-lavender in the central portion of the valve.

REFERENCES: *Pecten zealandiae*, GRAY, J. E., in Appendix, to DIEFFENBACH, E., Travels in New Zealand, with contributions to the geography, geology, botany and natural history of that country, 1843, vol. II, Fauna, Appendix, Mollusca, p. 261.

Pecten dieffenbachi, REEVE, L., Conch. Icon., 1855, vol. VIII, pl. 22, figs. 88a-b, text on page opposite to pl. 22.—HUTTON, F. W., Cat. Marine Mollusca, Wellington, N. Z., Colonial Museum Geol. Surv. Dept., 1873, pp. 81 and 82.

Family: SPONDYLIDAE

Genus: SPONDYLUS Linné

Spondylus nicobaricus Chemnitz

✓

Plate 133

TYPE: This was collected in the East Indies. Present depositary not located.

DISTRIBUTION: This species is rather widely distributed in the Indo-Pacific littoral zone. It has been reported from the East Indies (Chemnitz, Kobelt); the Philippine Islands (Cuming, Reeve), and the Queensland coast (Hedley).

MATERIAL EXAMINED: The "Alva" secured one large lime-encrusted specimen, another smaller specimen, supporting a vase sponge and two lower valves (upper valves missing), from the reef, Falcon Island, Palm Islands, Queensland, October 7, 1931.

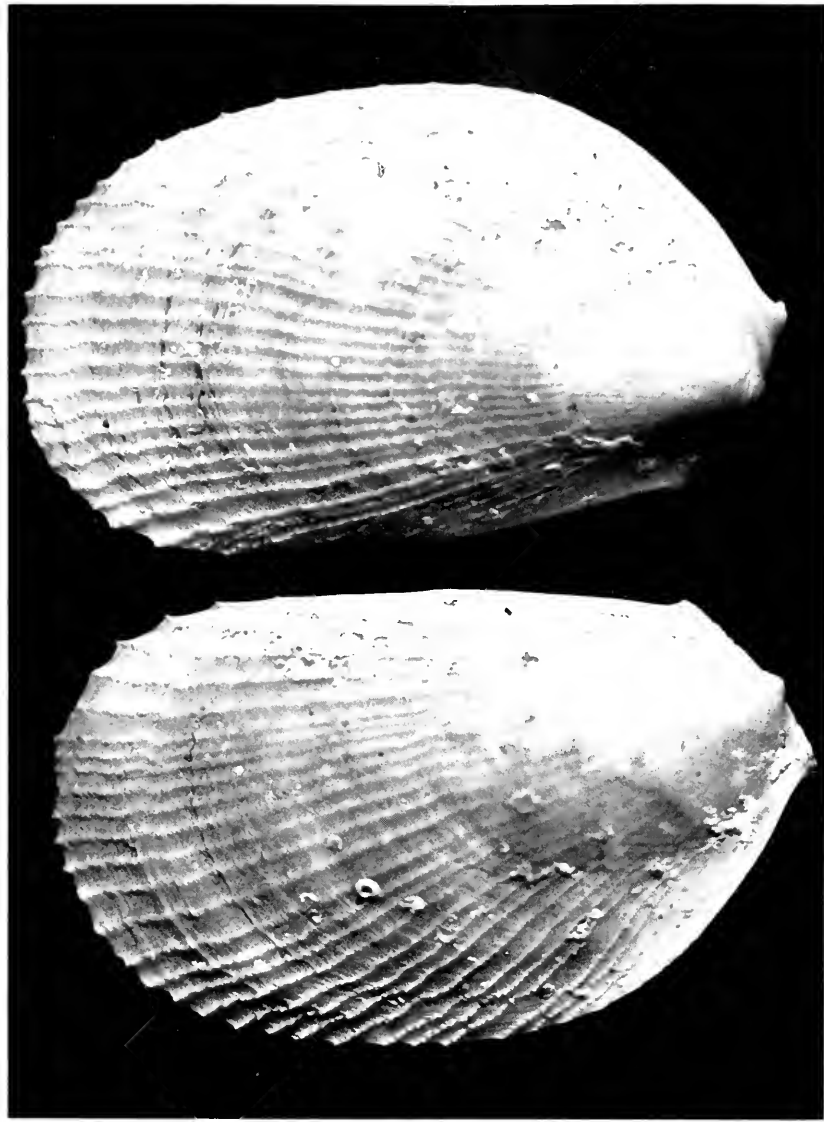
TECHNICAL DESCRIPTION: The largest "Alva" specimen is not quite as large as the one figured by Reeve, plate 14, figure 50, and is somewhat encrusted by calcareous algae. The second specimen, shown in plate 133, has the scales or spine-like teeth less eroded.

The shell is attached, inequivalve, slightly auriculated, the lower valve being frequently irregularly developed, the hinge area very large, flat, becoming more prominent with age. There are two solid reflected teeth in each hinge; these are very powerful, interlocking firmly, the ligament being inserted between them.

The upper valve is ovate, convex, moderately inflated, with twenty-four to thirty radiate striations, each beset with numerous, obliquely erect, acute triangulate scales or spine-like teeth, some of which are procurved and of varying sizes, ranging from approximately one-eighth to three-eighths inches long, forming a thorny covering over the entire upper valve, including the auricular region.

REFERENCES: *Spondylus nicobaricus*, CHEMNITZ, J. H., Conch. Cabinet, 1780-95, vol. VII, pl. 45, fig. 469, 470.—CHEMNITZ, J. H., u. Martini, F. H. W., Syst. Conch. Cab., Nurnberg, 1888, Bd. VII, pl. 4, fig. 3, u. pl. 9, figs. 2, 3.

Spondylus nicobaricus, REEVE, L., Conch. Icon, 1856, vol. IX, pl. 14, fig. 50 and text opposite.—HEDLEY, C., Rept. 12th Meeting Australasian Assoc. Adv. Sci., 1909, Proc. of Sect. D, Marine Mollusks of Queensland, 1910, p. 345.



Linaria (Linaria) fragilis (Gmelin), $\times 2$, from the reef, Falcon Island, Palm Islands, Queensland.



Lima (Linaria) fragilis (Gmelin), $\times 2$, from the reef, Falcon Island, Palm Islands, Queensland.

Order: **EULAMELLIBRANCHIA**Family: **LIMIDAE**Genus: **LIMA** CuvierSubgenus: **Limaria****Lima (Limaria) fragilis** (Gmelin)

1

Plates 134 and 135

TYPE: Gmelin's type locality is listed as rare in the Nicobar Islands. The type is deposited in the museum at Upsala.

DISTRIBUTION: This species has a bathymetric occurrence ranging from the littoral zone to 57 meters and is widely distributed in the Indo-Pacific, being known from Mauritius (Martens) eastward in the Nicobar Islands (Gmelin); at 16 "Siboga" stations in the Dutch East Indies and Sulu Archipelago (Prashad); Torres Straits (Jukes); Port Essington (E. A. Smith); Port Molle, Queensland (Coppinger); Queensland coast (Hedley); Palm Islands, Queensland (Boone), and eastward in the Fiji Archipelago, at Oomaga Reef (E. A. Smith), and Tahiti (Sowerby).

MATERIAL EXAMINED: Eight specimens, (seven and one-half bivalves), taken on the reef, Falcon Island, Palm Islands, Queensland, Australia, October 7, 1931.

TECHNICAL DESCRIPTION: The eight specimens of this delicately beautiful shell are typical representatives of *Lima fragilis*. The shell is equivalve, but little elongated, thin, with the hinge area narrow, the resilium nearly straight dorsally; the auricles small, the anterior one obtuse, the posterior acute. The shell is widely gaping on both sides, the margin of the posterior hiatus being formed by an internal rib. The umbo is small, prominent, somewhat conic, the adjacent and median region being nearly smooth except for a faint impress of the radiating costae; the dorsal surface with about 28 hollow, thread-like ridges that extend to the margin, making the latter slightly dentate or crenulate. Fine concentric lines of growth also pattern the surface, these being stronger near the margin, where they not infrequently retain a granulate appearance, due to these crenulate old marginal lines.

REFERENCES: *Pecten fragilis*, CHEMNITZ, J. H., Conch. Cab., 1784, Bd. VII, p. 267, 349, taf. 68, fig. 650.

Ostrea fragilis, GMELIN, J. F., in Linné, C. von, Syst. Nat., 1796, ed. XIII, p. 3332.

Lima fragilis, LAMARCK, J. B., Anim. sans Vert., 1819, t. VI, p. 157.—SOWERBY, G. B., Thes., 1843, vol. I, p. 86, pl. 22, figs. 34-37.—DANA, J. D., in Gould, A. A., in Wilkes', U. S. Explor. Exped. Mollusks, vol. XII, Atlas, pl. 43, fig. 573 (excellent colour plates made from living specimens).—PELSENEER, P., Siboga - Expeditie, Lamellibranches (anatomy), Monogr. LIII-a, Livr. LXI, 1911, p. 33-35, pl. 10, figs. 1, 3, 9.—PRA-SHAD, B., Siboga-Expeditie, Monogr. LIII-c, 1932, p. 124 (extensive synonymy).

Superfamily: OSTRACEA

Family: OSTREIDAE

Genus: OSTREA Linné

Ostrea cucullata Born

Plates 136 and 137

TYPE: Born's type of this species of coral-rock oyster came from Australia and is deposited in the Vienna Zoological Museum.

DISTRIBUTION: This species is found abundantly on the Queensland coast from the Gulf of Carpentaria and Cape York in the north to Tweed Heads, New South Wales (Kent). It is also known from Fiji, Samoa and other island groups of the Pacific (Hedley). Saville Kent states that this species is strictly marine.

MATERIAL EXAMINED: One small immature specimen was taken at Falcon Island, Palm Islands, Queensland, October 7, 1931.

REMARKS: The single specimen taken is quite young and has the normally deep valve less deep than usual and shows other evidence of having been subjected to an unusually crowded environment. It is the young of the variety *cornucopiæformis* Saville Kent, as illustrated in his chrome plate 14, figures 1, 2, 3, 4.



Ostrea cucullata Born, young specimen, $\times 1$, from Falcon Island, Palm Islands, Queensland; exterior of valves.



Ostrea cucullata Born, young specimen, $\times 1$, from Falcon Island, Palm Islands, Queensland; interior of valves.



Tridacna crocea Lamarck, exterior of left valve, $\times 1$, from Tahiti.



Tridacna crocea Lamarek, interior of left valve, $\times 1$, from Tahiti.

REFERENCES: *Ostrea cucullata* Born, Test. Mus. Caes. Vindobon, 1780, p. 122.

Ostrea mordax variety *cornucopiaeformis*, SAVILLE KENT, The Great Barrier Reef of Australia, 1893, London, p. 249, chrome plate 14, figs. 1, 2, 3, 4.

Ostrea cucullata, HEDLEY, CHARLES, in Marine Mollusca of Queensland, published as appendix, in Rept. Austral. Assoc. Adv. Sci., Brisbane, Queensland, vol. XII, p. 365.

Family: **TRIDACNIDAE**

Genus: **TRIDACNA** Lamarck

Tridacna crocea Lamarck

✓

Plates 138 and 139

TYPE: Lamarck's type came from the Indian Ocean and was first deposited in his cabinet, now in the Paris Museum.

DISTRIBUTION: This species is widely distributed in the littoral zone, usually in coral reefs, where it burrows in dead coral, from Aden and the Persian Gulf eastward through the Indo-Pacific in the Mergui Archipelago, Andaman Islands, Nicobar Islands, the Dutch East Indies, Singapore, the Gulf of Siam, the Philippines, Loo Choo Islands, Moluccas, Australia: Cape York, 8 fms. (E. A. Smith); Hope Islands (Hedley); Dunk Island, Queensland (Banfield); Low Islands, Queensland (Whiteley and Boardman); Lifu, New Ireland, Rarotonga and Society Islands.

MATERIAL EXAMINED: Two specimens from Teviatoa Reef, Raiatea Island, Society Islands, August 21, 1931; two specimens from Venus Point Reef, Tahiti, Society Islands, August 15, 1931.

DISCUSSION: This species is one of the three smaller Australian members of the *Tridacnidae* that burrow in dead coral. The shell possesses the very large pedal aperture, which distinguishes the boring from the perching species. The large, mushroom-shape foot protrudes through this aperture and excavates the cell in the coral, which is smooth inside and occupies considerable space within the rock to permit free movement of the mollusk and the opening and shutting of its valves. The entrance to

the cell is usually of much smaller diameter than the interior of the cell, prohibiting removal of the shell without injury. The mantle is richly coloured and very frilled. Dr. Hedley gives a most interesting photograph of a model of the burrow of *Tridacna crocea* cut open to show the natural position of the shell and animal, with the extended foot that excavated the cell, also a photograph of the mollusk embedded in a block of *Astrean* coral and a series of photographs of young *T. crocea*. Messrs. Whitley and Boardman (1929) have published an unusual photograph made by Mr. Boardman at Low Islands, Queensland, of living specimens of *T. crocea* burrowing in a block of coral rock.

One of the "Alva" specimens is shown in plates 138 and 139.

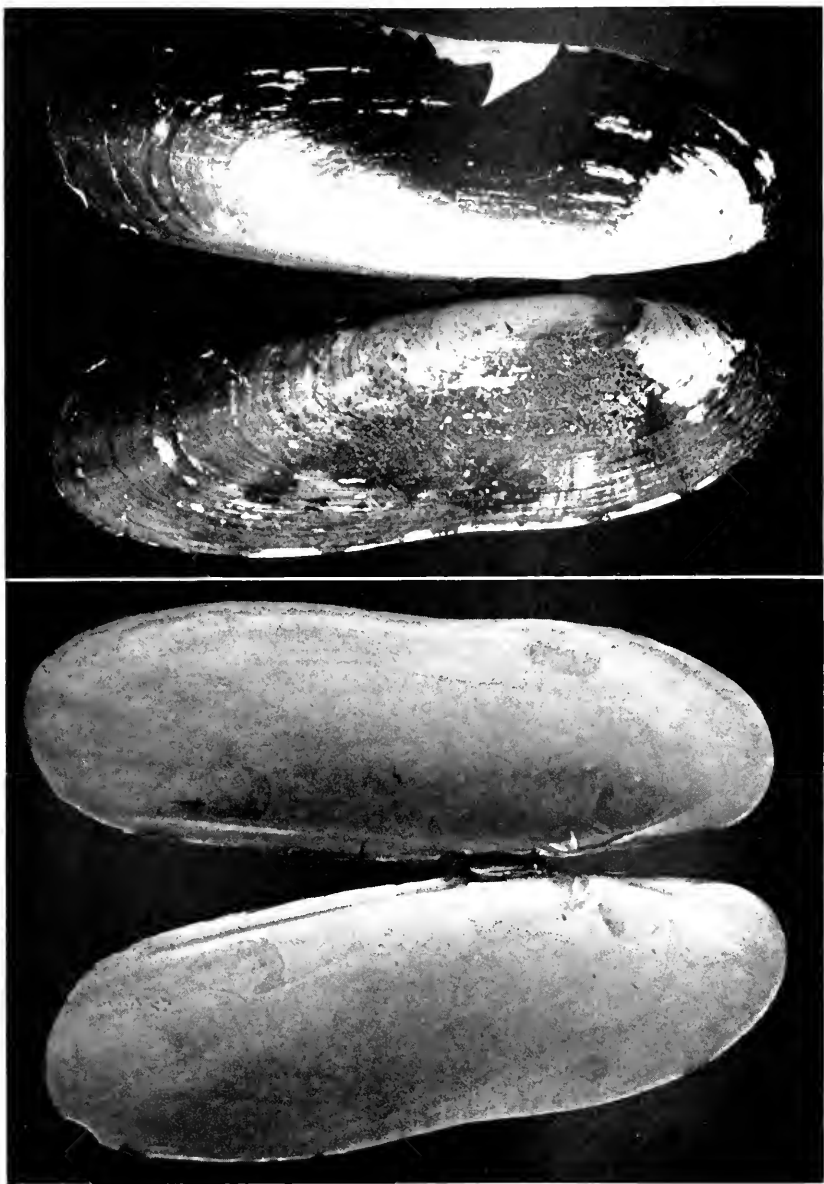
Dr. Hedley (1921) has given an excellent revision of the Australian *Tridacna*, which contains an extensive synonymy of the present species. Dr. Prashad (1932), in reporting the "Siboga" mollusks, has added to this.

Tridacna crocea possesses considerable variation in the shape of the valves, the degree of their tumidity and of sculpture. The squamae ornamenting the ridges varies from fragile, elevated scales to worn off lines on the surface.

REFERENCES: *Pectunculus striatus*, etc., LISTER, M., Hist. Conch., 1685, pl. 353, fig. 190.

Chama imbricata, CHEMNITZ, J. H., Conch. Cab., 1784, p. 124, pl. 49, fig. 496.

Tridacna crocea, LAMARCK, J. B., Anim. sans Vert., 1819, vol. VI, p. 106.—HEDLEY, C., Proc. Sect. D, Austral. Assoc. Adv. Sci., Brisbane, 1900, vol. XII, p. 348; Rec. Austral. Mus., 1921, vol. XIII, No. 4, p. 166, pl. 29, fig. 5, pl. 31, fig. 9, pl. 32, fig. 1, pl. 34, figs. 13, 14. — WHITELEY, G. P., and BOARDMAN, W., The Austral. Mus. Mag., April-June, 1929, vol. III, No. 10, p. 230 and text figure.—PRASHAD, B., Siboga-Expeditie, Monogr. LIII-c, 1932, Lamellibranchia II, p. 292.



Cultellus scalprum (Gould), $\times 1.25$, from Sourabaya, Java.

Family: SOLENIDAE

Genus: CULTELLUS Schumacher

Cultellus scalprum (Gould)

1

Plate 140

TYPE: This was obtained at Singapore and is deposited in the Philadelphia Academy of Natural Sciences.

DISTRIBUTION: Singapore (Gould); Gulf of Siam (Morlet, Lynge); Straits of Malacca, Pulo Penang, Salang, Mergui Archipelago, Java (Lynge); Sourabaya, Java (Boone).

MATERIAL EXAMINED: Seven specimens, in excellent series, from Sourabaya, Java, October 28, 1931.

TECHNICAL DESCRIPTION: The seven specimens taken by the "Alva" at Sourabaya are identical with the type obtained at Singapore, except that several of the present series are larger than the type.

The shell is fragile, thin, semitranslucent, the inner surface being delicately opalescent. The epidermis is light greenish yellow. The external surface is marked with fine lines of growth and radiating striae transversely elongate and widening posteriorly. The interior is widely gaping, bluish white. The shell has the dorsal and ventral margins somewhat rectilinear with the posterior end widely rounded, the beaks at the anterior fifth; the anterior end narrowed, rounded obliquely toward the sloping dorsal margin so that the tip is above the middle. The posterior umbonal slope is moderately tumid. The hinge (pl. 140) consists of two contiguous, narrow, compressed, divaricate teeth in the right valve and in the left valve a recurved, subulate tooth which interfits between those of the opposed valve and a smaller tooth immediately anterior to this. The anterior hinge margin is reinforced by an oblique ridge; the posterior hinge margin simulates a long, linear tooth, thicker on the right than on the left valve.

MEASUREMENTS: Long diameter 72 millimeters, transverse (median) diameter 24 millimeters.

REFERENCES: *Solen scalprum*, GOULD, A. A., Proc. Boston Soc. Nat. Hist., 1850, vol. III, p. 214, sp. 74; in Wilkes, C., U. S.

Explor. Exped., Mollusca, 1852, vol. XII, p. 388, atlas XII, pl. 33, figs. 502a-b.

Cultellus scalprum, VON MARTENS, E., Suss. u. Brackwasser Mollusken d. I Ind. Arch., 1897, p. 665, No. 2.—LYNGE, H., D. Kgl. Danske-Vidensk. Selsk. Skrifter 7 Raekke, natur. og. math. Afd. V, 3, 1909, pt. 4, p. 275 (with synonymy).

Class: CEPHALOPODA

Suborder: Decapoda

Division: Myopsida

Family: LOLIGINIDAE (d'Orbigny) emended

LOLIGO Lamarek

Loligo kobiensis Hoyle

✓

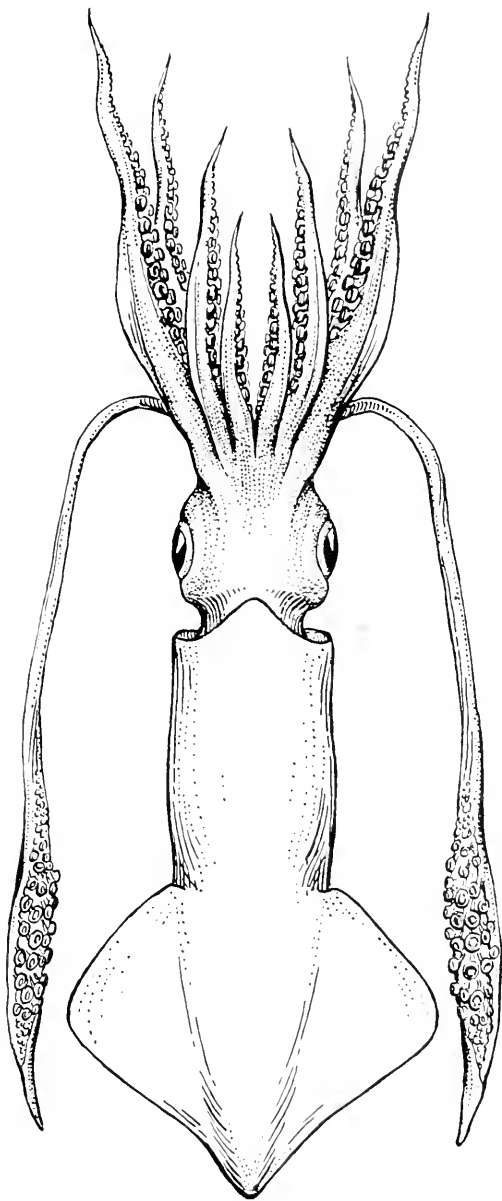
Plate 141

TYPE: This was secured by the "Challenger" at station 233, Bay of Kobe, Japan, 8 fathoms, mud bottom, May 17, 1875, and is deposited in the British Museum of Natural History. Four immature specimens were also taken by the "Challenger" expedition from the Inland Sea, Japan.

DISTRIBUTION: This species is known on the Asiatic coast from Japanese waters southward to the Malay Straits. It was not taken by the Ceylon Pearl Oyster Fisheries of the Gulf of Manaar and does not appear in Mr. Goodrich's report on the Calcutta Museum collections of Cephalopoda nor Mr. Berry's report on the Hawaiian Cephalopoda. While the "Siboga" report may give much additional concerning this species, M. Joubin's report is not yet issued, so the "Alva" material appears to be the first record of this species from the Malay Straits.

MATERIAL EXAMINED: Three specimens, taken by the "Alva" at Georgetown, Penang, Malay Straits, November 13, 1931.

TECHNICAL DESCRIPTION: This specimen is small, mature, with a body length of 60 to 70 millimeters. The body is obconical, about one-third as wide anteriorly as long, much tapered posteriorly to a blunt apex. The free mantle margin is produced to a wide triangle in the median dorsal line, from which it slopes to the lateral margin; it is produced to a small triangular point, on either side



Loligo kobicensis Hoyle, $\times 1$, from Georgetown, Penang, Malay Straits.

of the siphon and concave medially between these two points. The caudal fins are trapezoidal with rounded angles, being shorter on the paired anterolateral margins than on the posterolaterals. In the two larger specimens, the caudal fins occupy a little more than one-half of the body length, but in the smaller specimen the caudal fins equal little more than one-third of the body length. The exposed portion of the siphon is short, broad, rounded, with a moderately broad aperture. The head is slightly wider than long, dorso-ventrally compressed, rounded; the eyes are large, lateral. The arms decrease in length in the order 3, 4, 2, 1, with the third and fourth pairs dorsally webbed. The suckers of the sessile arms are moderately large, pedunculate, set obliquely, in two rows approximately, with the lateral margin on either side marginally produced into a thin ribbon-like webbing. The suckers of the third pair are distinctly larger than those of the other pairs of arms. The horny ring of one of these large suckers has eight to nine short, square-cut, close-set teeth on the distal side, the proximal half being smooth. The hectocotylus is not present.

The outer buccal membrane is produced into five decided points, each of which bears a cluster of 2, 3 or 4 small suckers; the two ventral points are curtailed. Within the margin of the membrane, in the median ventral area are numerous small papillae, for the attachment of spermatophores. Both membranes are much folded, the inner one fitting closely around the beak. The beak is of the usual *Loligo* type, very powerful.

The tentacular arms (even in dead specimens) are exceedingly long, being one and one-half times the combined length of the body, head and sessile arms. The tentacular arms are very slender, sub-cylindrical, with the distal fourth supporting the club, which is little expanded, narrowly ovate in contour, with the lateral margins produced into a ribbon-like protective margin; externally the club bears a well defined web. The suckers are set in approximately four series, there being 18 to 20 proximally; small, but distally gradually increasing in diameter. There are eight to ten large median suckers, each of which is about twice the diameter of the adjacent alternating lateral suckers; beyond these there are about twenty to twenty-two smaller suckers, continuing the four-row arrangement and gradually decreasing in size toward the tip. The small cups are set obliquely, the larger ones but little so and have the free margins marked by radial lines (? possibly due to

death and muscle contraction). The horny rings of all the large suckers are smooth, except one which is continuously cut into short, narrowed, acute, triangular teeth, the space between each of which is about equal to one tooth inverted.

The suckers of the two lateral dentate cups have similar triangular teeth on their outer margins and their inner margins with rudimentary teeth or smooth.

The skin is typically *Loliginid*, smooth, flesh colour, with numerous small, purplish chromatophores.

The pen is typical, with the narrowed anterior portion gradually expanded to form the blade.

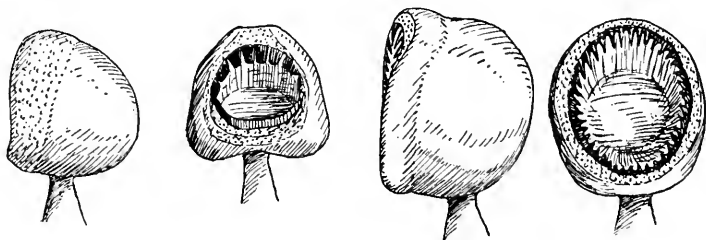
REFERENCES: *Loligo kobiensis*, HOYLE, W. E., Ann. Mag. N. H., ser. 5, vol. XIV, 1885, II, p. 184; Proc. Roy. Soc. Edinb., 1885, vol. XIII, p. 287; Rept. Sci. Res. Voy. H. M. S. "Challenger" Zool., 1886, vol. XVI, p. 154, pl. 25, figs. 1-10.

Loligo diomedae Hoyle

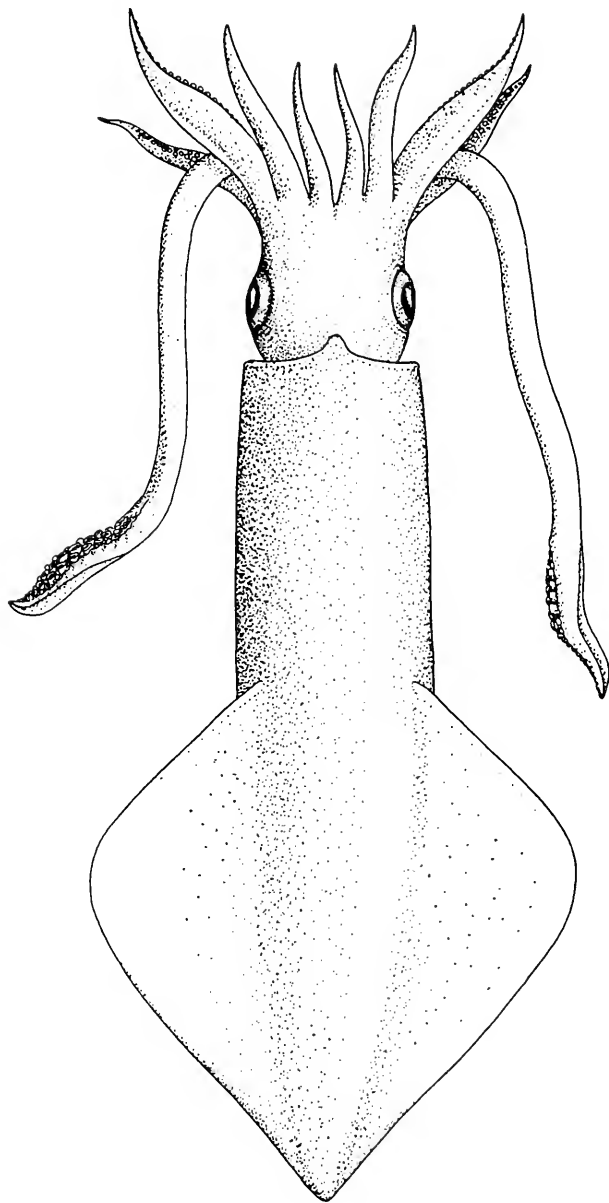
1

Volume IV, plate 112

MATERIAL EXAMINED: One specimen, having a mantle length of 51 millimeters, labeled Panama City, Panama, Pacific Ocean, July 24, 1931, collected by the "Alva" World Cruise. One specimen, with a mantle length of 80 millimeters, collected at Valpa-



Text figure 18.—*Loligo diomedae* Hoyle: left figures; profile dorsal views of a sucker from the third right sessile arm; right figures; profile and dorsal of a large sucker from the left tentacular arm of a specimen from Valparaiso, Chile; $\times 12$.



Loligo indica Pfeffer, $\times 1.15$, from Cebu, Cebu Island, Philippine Islands.

raiso, Chile, February 4, 1935, by the "Alva" South American Cruise, 1935.

DISCUSSION: This rather rare *Loligo* was previously reported in the Vanderbilt collections, from fifty miles southwest of Cape Mala, Panama, from surface to 300 fathoms dredge haul, also from Punta Arenas, Costa Rica, in a 100 fathom haul, and is fully described and figured in Bulletin IV, p. 180, plate 112.

The present Panama City specimen, which has both tentacular arms broken off, agrees with the preceding description in other essentials, except that the suckers of the sessile arms are curiously almost entirely devoid of the usual horny rings. The few suckers which do have horny rings show the dentition characteristic of *Loligo diomedae*. The difference existing is too trivial to merit attention. The present writer has not infrequently noted similar variation in the dentition of the sucker rings of the better known east coast species, *Loligo pealeii* (Leseuer).

The Chilean specimen, which is typical *diomedae*, is of exceptional interest, since it is the first record of the species so far south. The previous records included the Gulf of California and Panamic province. The dentition of a large sucker from the third right sessile arm and from a large sucker of the left tentacular arm are shown in text figure 18.

REFERENCES: *Loligo diomedae*, HOYLE, W. E., Bull. Mus. Comp. Zool., 1904, vol. LXIII, p. 29, pl. 5, fig. 13, pl. 6, figs. 1-7.—BOONE, L., Bull. Vanderbilt Marine Mus., 1933, vol. IV, p. 180, pl. 112 (with complete discussion).

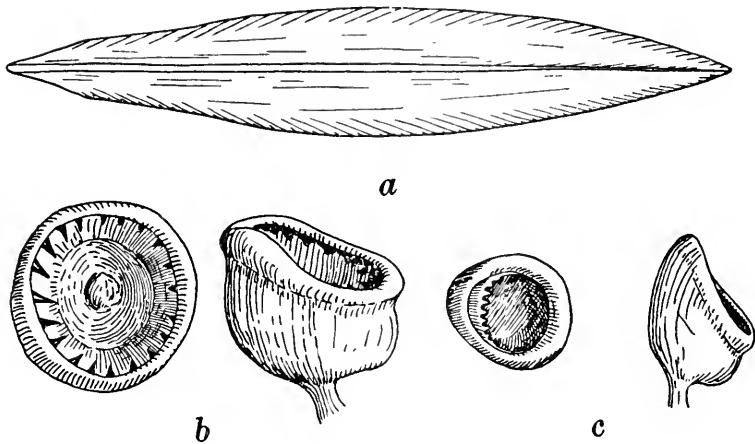
Loligo indica Pfeffer

✓

Plate 142

TYPE: Pfeffer's type was collected in Java and is deposited in the Hamburg Zoological Museum.

MATERIAL EXAMINED: Nine specimens, taken with marine light, Cebu, Island of Cebu, Philippine Islands, January 18, 1929, by the "Ara."



Text figure 19.—*Loligo indica* Pfeffer: a, pen, $\times 1$; b, a large sucker from the tentacular arm, $\times 20$; c, a large sucker from the sessile arm, $\times 20$.

DISTRIBUTION: In addition to the type from Java (Pfeffer), thirteen specimens of this species were taken by the "Challenger" in the Arafura Sea, south of Papua, at station 188, in 28 fathoms, and at station 190, in 49 fathoms. Subsequently Mr. Goodrich reported eight specimens in the Calcutta Museum collections, from Mergui, one from Camorta Harbor, one from Daley Sandheads, two from the mouth of the Mutlah River and one from the Chilka Bight. This species was not taken by the Ceylon Pearl Oyster Fisheries Investigation in the Gulf of Manaar, nor by the J. Stanley Gardiner expedition of 1899-1900, in the Maldiva and Laccadive Archipelagoes. Neither the reports of the United States Bureau of Fisheries Steamer "Albatross" biological investigations in the Philippine Archipelago and adjacent regions, 1907-10, Cephalopoda, nor those of the "Siboga"-Expeditie in Nederlandsch Oost-Indie, 1899-1900, have been published, hence the "Ara" record becomes the first Philippine record for this species, as well as the most northern station for it. *Loligo indica* Pfeffer apparently has its center of distribution in the Sunda Isles, extending westward to Mergui Archipelago, northeastward to Cebu, Philippine Islands, eastward to the Arafura Sea, south of Papua. The collected specimens are deposited in the natural history museum in Hamburg (type), London ("Challenger") and Calcutta ("Investigator"), so the "Ara" catch of nine specimens, deposited in the

Vanderbilt Marine Museum, at Northport, N. Y., are the only specimens of this species known to be in any American museum.

TECHNICAL DESCRIPTION: The largest of the Cebu specimens is fully matured, has a total body length of 100 millimeters. The body is obconical, of about 25 millimeters diameter anteriorly and very tapered posteriorly to a blunted apex. The free mantle margin is produced anteriorly to a distinct rounded triangular process in the median dorsal line from which it slopes to the lateral margin; ventrally this margin is shallowly widely concave beneath the siphon and produced to a blunt triangular point on either side. The caudal fins are each triangular, with the outer angle rounded, the anterior lateral margin only three-fourths as long as the post-lateral margin, the paired fins outlining a rhombic figure. In adults the length of the fin is slightly more than one-half the total body length, those of the present specimen being 55 millimeters long on a body 100 millimeters long. In younger specimens the fins are much shorter in ratio to the body length, those of the very young being not quite one-third of the total body length, with the margins rounded, somewhat heart-shaped; those slightly larger have the posterior portion of the fins more attenuate, subacuminate.

The exposed portion of the siphon is short, distally bluntly rounded, with a moderately broad aperture, divided by an inner transverse septum.

The head is wider than long, dorsoventrally compressed, rounded; the eyes are large, lateral.

The sessile arms decrease in length in the order 3, 4, 2, 1, with the first and second pairs of arms each dorsally webbed on the outer side; the third pair are similarly webbed but for a shorter space, while the fourth pair are webbed along the upper lateral margin. The suckers of the sessile arms are moderately large, pedunculate, set obliquely, in two rows approximately, with the lateral margin on either side produced into a thin, ribbon-like webbing. The suckers of the third pair of arms are eighteen per row and are distally larger than those of the other pairs of arms. The horny ring of one of these large suckers has eight sharp, close-set, triangular teeth on the distal side, the proximal half of the ring being smooth.

The outer buccal membrane is produced into five distinct points, one attached between the first pair of arms, one each to

each arm of the second pair, and one each, to each arm of the third pair; the ventral two points are reduced and are attached to the bases of the fourth pair of arms. Within the margin of the membrane in the median ventral area there are numerous small, rough papillae for the attachment of the spermatophores. Both membranes are very muscular, the inner one fitting closely around the powerful beak.

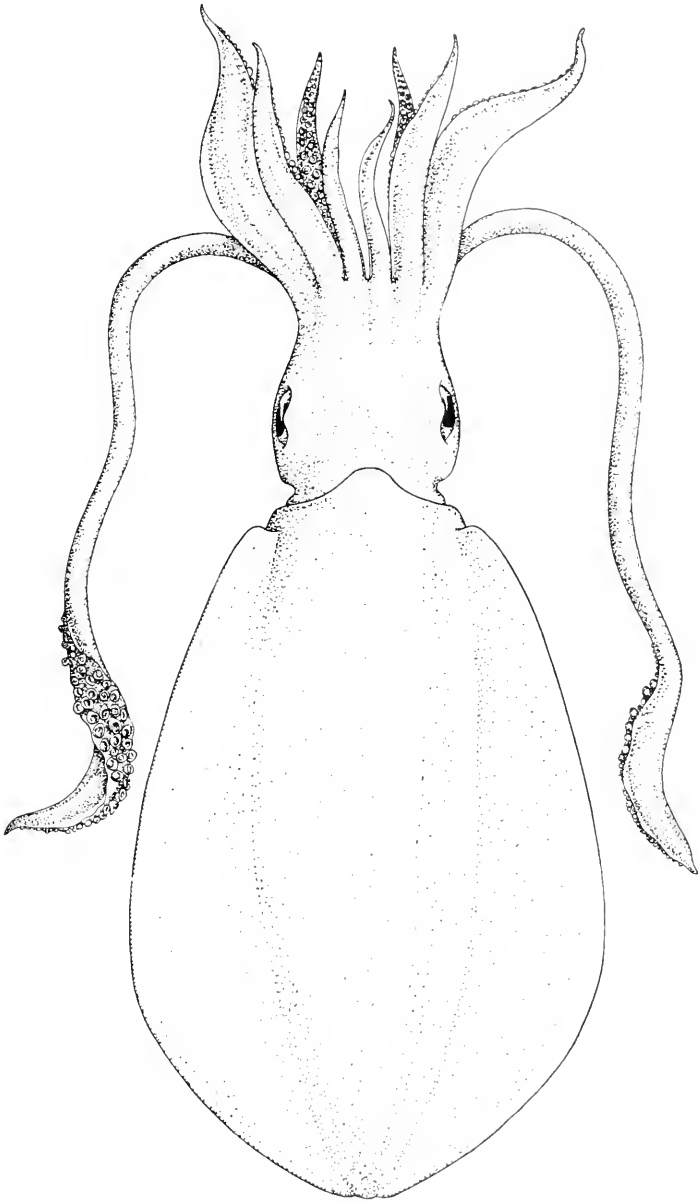
The tentacular arms are moderately long, slender, subcylindrical, the distal fourth supporting the club, which is slightly expanded, narrowly ovate in contour, with the two lateral margins produced into a narrow ribbon-like protective margin; externally the club bears a well defined web. The suckers are arranged in four longitudinal series. There are ten to twelve small suckers proximally, beyond which the suckers of the two inner rows are decidedly larger, the series increasing in size distally to midway the club, thence decreasing moderately for two-thirds the length of the club, the suckers on the distal third of the club being small and closely crowded. The large suckers each have a continuous ring of eighteen narrow, deep, distally acuminate teeth, separated from each other by a narrowed triangular space about equal to one tooth, in reverse position; these teeth are smallish on the proximal half, those of the distal half increasing in size, so that the largest teeth are nearly twice the size of the smallest ones. (See fig. 19). The pen is shown in figure 19.

REFERENCES: *Loligo indica*, PFEFFER, G., Cephal. des Hamburger Naturh. Mus., Abh. Naturwiss. Ver. in Hamburg, 1884, Bd. VIII, abth. I, p. 4, figs. 3-3a.—HOYLE, W. E., Rept. Voy. H. M. S. "Challenger" Zool., 1886, vol. XVI, p. 156, text fig. 8, and pl. 26.—GOODRICH, E. S., Trans. Linn. Soc., London, Zool., 1896, ser. 2, vol. VII, p. 7, pl. 2, figs. 20-28.

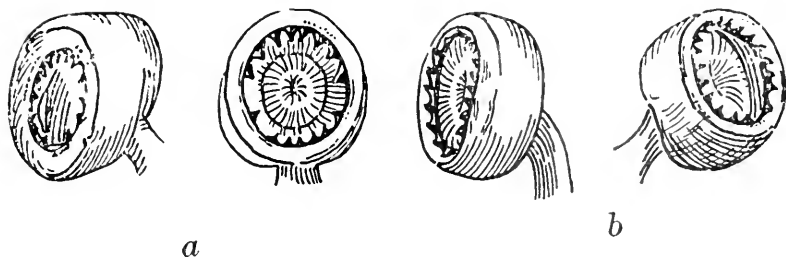
Genus: SEPIOTEUTHIS de Blainville
Sepioteuthis mauritiana Quoy and Gaimard

1
Plate 143

TYPE: The type of this species was taken by the French government's voyage of discovery of the "Astrolabe" in 1826-1829,



Sepioteuthis mauritiana Quoy and Gaimard, $\times 0.4$, from Noumea, New Caledonia.



Text figure 20.—*Sepiotenthis mauritiana* Quoy and Gaimard: a, two views of a large sucker from the third sessile arm showing typical dentition; b, two views of a large sucker from the tentacular arm, showing typical dentition; all $\times 5$.

in the waters of Mauritius (Ile de France) and is deposited in the collections of the Paris Museum d'Histoire Naturelle.

DISTRIBUTION: Mauritius (Quoy and Gaimard, Tryon, Hoyle); New Caledonia (Boone).

MATERIAL EXAMINED: Four large specimens, taken at Noumea, New Caledonia, September 19, 1931, by the "Alva" World Cruise.

COLOUR: The colour of the living specimen is a pale flesh colour, abundantly tinted with thousands of large violaceous-red chromatophores on the body, fins, head and arms.

TECHNICAL DESCRIPTION: This species is represented in the present collection by specimens ranging from 1.5 to 2 feet total length, exclusive of tentacular arms.

The body is 10 inches, or 25 centimeters, long in the median dorsal line, and is large, wide, subcylindrical, tapering posteriorly, bluntly rounded distally; anteriorly the free margin is produced to a blunt triangular median point, on either side of which it tapers toward the lateral margin; on the ventral surface the free margin is concave medially below the siphon and produced into a subacute point on either side of this. The caudal fins occupy almost the entire lateral margin of the body, beginning a very short distance behind the free anterior margin, increasing gradually in width posteriorly, attaining their maximum width 0.6 of the body length from the anterior margin, thence gradually tapering posteriorly on the hinder 0.4 of the squid, terminating at the posterior apex of the body. These fins are broad, thick, fleshy, subrhomboidal, when considered as a pair; the outer margin of each fin forms a wide, convex arc; considered as a whole, the body and fins together

form a long, wide, oval, with a long diameter of ten to eighteen inches and a short diameter of seven to twelve inches.

The head is large, flattish dorsally, somewhat rounded laterally, with large prominent eyes and with a decided triangulate depression on the median ventral surface into which the dorsal side of the siphon fits. The siphon extends to the base of the fourth pair of arms.

The outer buccal membrane is well developed, with the circumferal margin produced into usual *Sepioteuthis* arrangement, each point bearing three to five suckers, which have dentate horny rings. The beak is very powerful.

The sessile arms are in the order 3, 4, 2, 1. The cupules are in four rows. A typical large sucker taken from about midway the third right arm is shown in text figure 20. The horny ring of this sucker is regularly set with laciniate, triangular teeth which are coarser on the upper portion of the ring, but are also present in reduced form on the lower or ventral portion of this ring.

The tentacular arms are quite long and very strong, compressed, the clubs large, occupying about .30 of the visible portion of the arm, bearing a median web or keel on the dorsad, also a ribbon-like web along the lateral margins. The suckers are arranged in four closely crowded series, those of the two inner series being larger in the median area of the club. A typical example of one of these large cupules is shown in text figure 20, b. The horny ring is continuously set with coarse, approximately subequal triangular teeth, which are separated from each other by an area approximately equal to one tooth reversed in position.

REFERENCES: *Sepioteuthis mauritiana*, QUOY, J. R. C., et GAIMARD, J. P., Voy. de Decouvertes de "L'Astrolabe," 1826-1829, M. J. D. D'Urville, Com., Zool., 1832, t. II, p. 76, atlas II, pl. 4, figs. 2-6.—D'ORBIGNY, A. D., ET FERUSSAC, A. S., Hist. Nat. Gen. et Cephal. Acetab. vivants et Fossiles, 1835-1840 (1839), p. 300, *Sepioteuthis*, pl. 5, fig. 5, pl. 6, figs. 15-21.—HOYLE, W. E., Rept. Voy. H.M.S. "Challenger," Zool., 1886, vol. XVI, p. 27; Proc. Zool. Soc., London, 1907, p. 450.

OEGOPSIDASuborder: **Enopleuthinae**Tribe: **ENOMORPHAE** ChunFamily: **ENOPELUTHIDAE**Genus: **ABRALIOPSIS** Joubin***Abraliopsis morisii*** (Verany)

✓

TYPE: This was taken from the stomach of an ordinary dolphin, captured at 39° Lat. N. 29° Long. The depository is not cited, but is probably the natural history museum at Turin. The species was named in honour of Dr. Morisi, author of the "Flore de la Sardigne."

DISTRIBUTION: This lovely little deep-sea Oegopsid has been reported from the type locality (Verany); Mascarenes Islands (Pfeffer); Villefranche, Mediterranean (Joubin); Gulf of Bengal (Goodrich); Atlantic Ocean region (Hoyle); "Valdivia" station 54, Guinea Stream, stations 223-228, 231, Bay of Chagos Archipelago, and stations 256, 265, Indian North Equatorial Stream, in depths varying from 628 to 1,134 meters (Chun); Flores Strait, 140 fathoms (Boone).

MATERIAL EXAMINED: One young adult specimen and two post-embryonic stage specimens, dredged in 140 fathoms (500 meters of wire out), in Flores Strait, near Larantuka Village, Flores Island, Dutch East Indies, October 22, 1931.

REMARKS: This exquisite deep-sea species has been exhaustively analyzed by Dr. Chun (1910), whose excellent illustrations portray the delicate translucent beauty of this interesting Oegopsid. The single adult specimen taken by the "Alva" is nearly the size of the specimen from the Guinea Stream, "Valdivia" station 54, shown by Dr. Chun in plate 6, figure 2, and is about one-half as large as the adult male with hectocotylized arm from the same "Valdivia" station, shown in figure 1, of the same plate.

The Flores Strait specimen has the following measurements (in millimeters):

Dorsal mantle length.....	8.5
Length of head	2.5
Width of head between the eyes.....	4

Length of siphon on ventral side.....	3
Transverse greatest width of fins.....	6
Length of fins, at insertion.....	4.2
Length of fourth, or ventral, pair of arms.....	8
Length of third pair of arms.....	7.7
Length of second pair of arms.....	6.2
Length of first, or dorsal, pair of arms.....	4.9

The chromatophores are numerous, large, arranged in approximate longitudinal series on the mantle, siphon, the proximal portions of the central surface of the arms and are even more numerous on the ventral surface of the head.

The left eye (viewed ventrally) is somewhat extruded from the normal position, shows four of the five large light organs also greatly dilated. The right eye shows all five light organs in normal position.

The large suckers of the tentacular arms have the horny rings set with a continuous series of acute triangular teeth, separated by reversed narrow triangular spaces. The majority of the smaller suckers are seen to be similarly dentate, when placed under high magnification.

Two very young stages of *Abraliopsis morisii* were taken in the same haul as the preceding specimen, in Flores Strait. These are similar to the young stages figured by Dr. Chun in plate 7, figures 9 and 12, *loc. cit.*, but both of the present specimens represent a slightly younger larval stage, possibly the first post-egg stage, as in the smaller specimen the impress of the embryonic folding of the larva is retained, as well as the remnants of the egg-sac. The larger specimen also has this in less degree. Each has the characteristic series of five light organs present in the ventral orbital area. The mantle and head is covered with prominent chromatophores. The ventral pair of arms have the free ribbon-like external webbing folded over ventrally, close to the margin of the siphon.

The larger specimen measures: Mantle length, 4 millimeters; head to base of the dorsal arm, 1 millimeter; median width, 2 millimeters; length of arms: ventral, of first pair, 1.4 millimeters; second pair, 3.0 millimeters; third pair, 2.0 millimeters, and fourth, or dorsal, pair, about 1.5 millimeters.

The youngest specimen has a mantle length of 2.5 millimeters, is 2 millimeters long to the base of the dorsal pair of arms. The sessile arms all are embryonic and have the web deeper in ratio between the bases of the arms than is true of the older larval stages. This specimen has the tentacular arms extended for a length equal to three-fourths of the total length of the body and head, but unfortunately both arms are broken off distally.

REFERENCES: *Onychoteuthis morisii*, VERANY, J. B., Mem. Acad. R. Sci. Torino, ser. 2, t. I, 1837, p. 2, taf. 2A.

Abraliopsis pfefferi, JOUBIN, L., Bull. Soc. Sci. et Med. de l'ouest, Rennes, 1896, pp. 19-35, figs. 1-10.

Abraliopsis morisii, CHUN, C., Wiss. Ergeb. Deutschen Tiefsee Exped. "Valdivia," 1898-99, Die Cephalopoden, Bd. XVIII, teil I, II, 1910, p. 78, taf. 5, 6, 7, 8, 9, 10 and p. 102, pl. —, taf. 7, figs. 1-13.—NAEF, ADOLF, Fauna u. Flore des Golfes von Neapel, Die Cephalopoden, monogr. XXXV, 1923, p. 285, text figs. 137, 138, 139, 140, 141, 142. (This contains exhaustive diagnosis and synonymy.)

Order: DIBRANCHIATA

Suborder: Decapoda

Family: ONYCHOTEUTHIDAE

Genus: ONYCHOTEUTHIS Lichenstein

Onychoteuthis banksii Leach

7

Plate 104, volume IV

MATERIAL EXAMINED: Eleven young specimens 2 to 3.5 inches long, taken with marine light at the "Ara's" anchorage, in 15 fathoms, Sindangan, northwest Mindanao, Philippine Islands, January 17, 1929.

REMARKS: This sea-arrow, remarkable for its nearly cosmopolitan distribution in all the oceans, from the Arctic to the Cape of Good Hope and southern reaches of the Indian Ocean and also throughout the Pacific and Atlantic Oceans, is again recorded in the Vanderbilt Marine Museum, this time from the Sulu Sea, Zam-

boangan coast of Mindanao. For full discussion of the species refer to Bulletin of the Vanderbilt Marine Museum, volume IV, p. 165, pl. 104, 1933.

Family: **OMMATOSTREPHIDAE**

Subfamily: **Ommatostrephinae**

Genus: **OMMATOSTREPHEs** d'Orbigny

Ommatostrephes sagittatus (Lamarck)

✓

TYPE: Lamarck cites "Habite l'ocean europeen et americain. Collect. du Mus." (Paris Museum d'Histoire Naturelle).

DISTRIBUTION: This is one of the rapid and powerful swimmers of the open sea, known as "sea-arrows." It is widely distributed in the Mediterranean Sea, the Atlantic coasts of Europe northward to Denmark, northern Norway, also the ocean shores of Greenland; southward it is known from the Hispanic coast, the Canary Islands, and off northwest Africa. The Atlantic Ocean distribution of this species appears to coincide with the paths of the Eastern Current of the Gulf Stream and of the Rennell Current.

MATERIAL EXAMINED: One *Rhynchoteuthis*-stage (Chun), taken in 250 fathoms, off Fuerte Ventura, Canary Islands, Puerto Cabras, bearing 270° true seven miles distant, February 18, 1932.

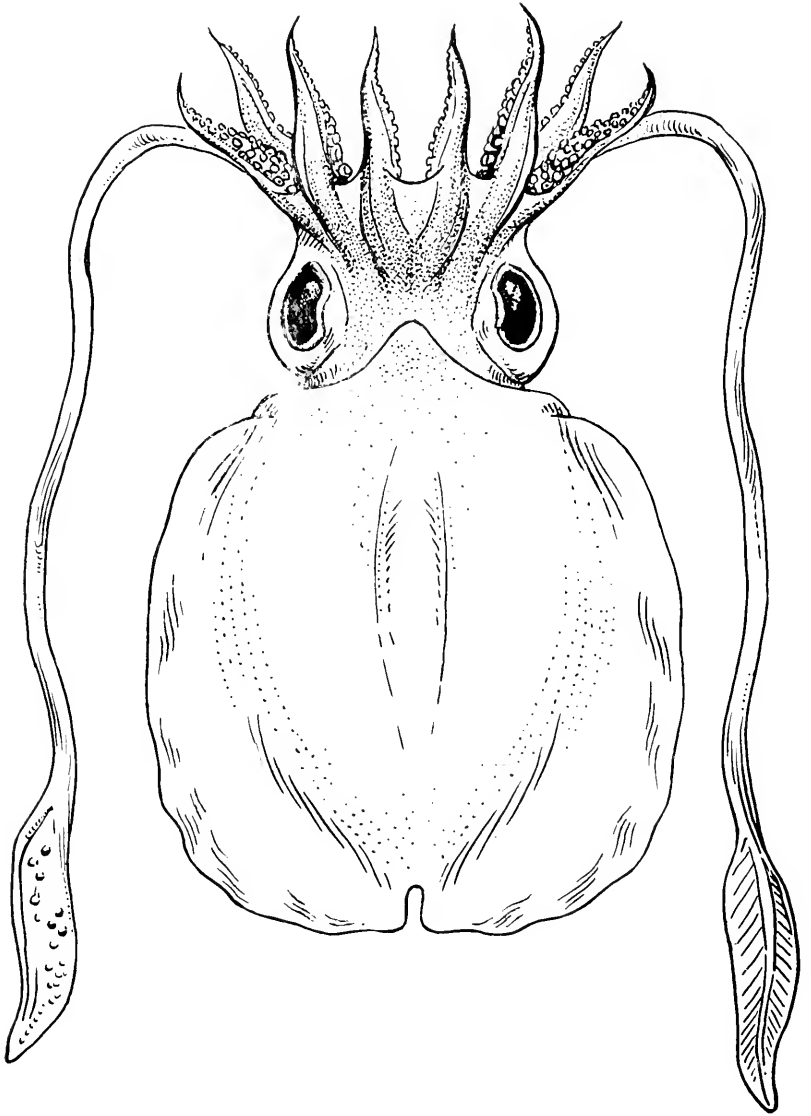
REMARKS: This specimen, which has a body length of 4.5 millimeters in the median dorsal line, is in about the same stage of development as that shown by Mr. Naef (1923), in text figure 211 of a specimen he had from Naples plankton. The caudal fins of the present specimen are subterminal, slightly deformed. Naef's excellent study of both the larval and adult forms of this species and Dr. Chun's study of the *Rhynchoteuthis* form render additional description of this larval squid unnecessary.

REFERENCES: Seba, A., Mus. 3, t. 3, f. 5, 6, et 4 f, 3-5.

Loligo sagittatus, LAMARCK, J. B., Anim. sans Vert., 1799, t. VII, p. 663.

Loligo sagittata, CARUS, C. G., Icones Sepiarum in littore maris Mediterrane collectarum, 1824, p. 318, t. 30.

Ommatostrephes todarus, FERUSSAC, A. E., and D'ORBIGNY, A.,



Sepia rouxii d'Orbigny, $\times 1$, from Georgetown, Penang, Malay Straits.

Hist. Nat. Cephal. Acetab. vivants et fossiles, Paris, 1839, p. 349, pl. 2.

Ommatostrephes sagittatus, FORBES, EDW. and HANLEY, SYL., Hist. British Mollusca and their Shells, 1853, vol. IV, p. 233, t. RRR.—NAEF, ADOLF, Die Cephalopoden, Fauna u. Flora des Golfes von Neapel, Monogr. XXXV, teil I, Bd. I, 1923, p. 445, text figs. 228-251, and pl. 6, figs. 1-3, pl. 12, figs. 2 and 5, pl. 14, fig. 6, pl. 17, fig. 10, Bd. II, pls. 9, 10 and 11 (egg and larval stages; Dr. Naef gives an exhaustive study of this species from egg to adult, with major synonymy to 1923).

Rhynchoteuthis, CHUN, C., Zool. Anz. Bd. XXVI, 1903, p. 716, and three text figs.; Wiss. Ergeb. Deutsch. Tiefsee Exp. Valdivia, and three text figs.; Wiss. Ergeb. Deutsch. Tiefsee Exp. "Valdivia," 1910, Bd. I, Oegopsida, p. 201, pls. 28, 29.

Suborder: **Sepioidea**

Family: **SEPIIDAE**

Genus: **SEPIA** Linné

Sepia rouxii d'Orbigny

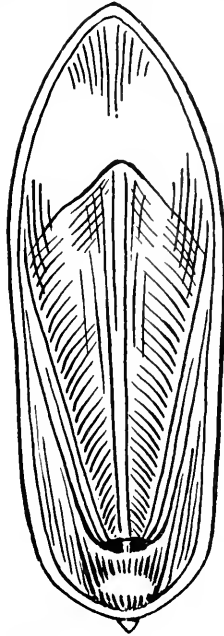
✓
Plate 144

TYPE: The type locality cited by d'Orbigny is "Red Sea; Bombay." His material is deposited in the Paris Museum.

DISTRIBUTION: This species is known from the Red Sea eastward, including Suez (Hoyle), off Negombo, Gulf of Manaar (Hoyle), Bombay (d'Orbigny), Mulaki Atoll, Maldives, 28 fathoms, and eastward and northward beyond Formosa, including the Philippine Archipelago, Papua, New Guinea, and the Malay Archipelago and probably the northern coast of Australia (Hoyle); Georgetown, Penang, Malay Straits (Boone).

MATERIAL EXAMINED: One specimen, taken at Georgetown, Penang, Malay Straits, November 13, 1931.

TECHNICAL DESCRIPTION: Body stout, compressed, subcylindrical, tapering posteriorly to a subacute apex. Anteriorly the free edge is produced to wide, blunt, triangular point on the median dorsal area, on either side of which it tapers toward the lateral margin; on the ventral surface the median margin is widely, slightly concave below the siphon. The caudal fins begin a short

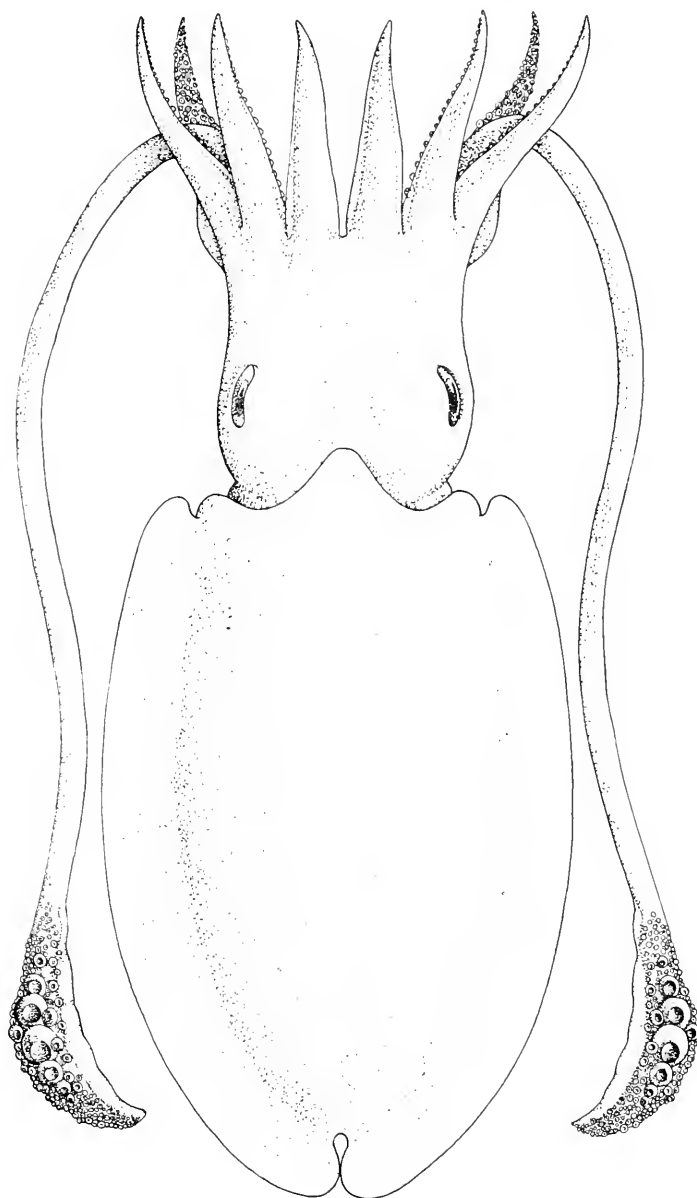


Text figure 21.—*Sepia rouxii* d'Orbigny, ventral view of gladius, $\times 1$.

distance (about 6 millimeters in the present specimen) behind the mantle edge and anteriorly the fins are narrowed, gradually widening, being widest on the posterior two-thirds of their length, where they attain a width of 10 to 12 millimeters in the present specimen; posteriorly the margin of each fin is widely rounded, the two being very narrowly separated posteriorly.

The head is of moderate size, wider than thick, flattish dorsally, somewhat convex laterally and with a distinct median depression ventrally into which the dorsal surface of the siphon fits. The eye is lateral, large, with a prominent pupil.

The outer buccal membrane is well developed with its distal margin produced into seven points: one point extends between the two dorsal arms, one point each between the dorsal and upper lateral arms, one point each between the margins of the lower lateral and ventral arms, and the seventh point occurs between the ventral pair of arms. The exposed surface of the outer buccal membrane is smooth, except for marginal plaitings or ribbing, apparently due to the constricted condition of the muscles in the dead specimen. The inner buccal membrane is very muscular and closely surrounds the beak. The exposed inner surface of the inner



Scipia officinalis Linné, $\times 0.35$, from Naples, Italy.

buccal membrane bears a continuous series in approximately six rows of numerous closely-set, fleshy, soft-bodies, denticle-like, distally blunted papillae. The lower mandible is strong, sharp, closely coordinated with the upper mandible.

The sessile arms are short, in the sequence 4, 3, 2, 1, the increase in length of the successive pairs being but very little; likewise the depth of the umbrella or web is about the same between pairs 1, 2 and 3. The pairs 3 and 4 are each longitudinally ribbed, or carina-like on their respective upper second and lower third lateral margins. The suckers are set obliquely, in four approximate longitudinal series and each furnished with a chitinous ring which is devoid of teeth.

The tentacular arms are withdrawn in the present specimen, except for the distal portion of the left one, which bears numerous small suckers, in six or seven series set across the somewhat triangulate form of tentacle.

REFERENCES: *Sepia rouxii*, FERUSSAC, A. DE, et D'ORBIGNY, A., Hist. nat. gen. et partic. des Cephal. Acet. vivants et fossiles, Paris, 1835-48, p. 271; Atlas, pl. 19.—HOYLE, WM. E., Rept. Sci. Res. Voy. H.M.S. "Challenger," Zool., 1886, vol. XVI, p. 22, p. 218.

Sepia rouxi, HOYLE, W. E., in Gardiner, S., Fauna and Geog. Maldive and Laccadive Arch., vol. II, art. 26, 1902, p. 981; Journ. Linn. Soc. Zool., 1907, vol. XXXI, p. 42; in Herdman, W. A., Rept. Ceylon Pearl Oyster Fisheries, 1904, pt. III, a suppl. 14, p. 198.

Sepia pharaonis, EHRENBERG, CH. G., Symbolae Physicae, Pars I, Zoologica, Berlin, Moll. Ceph. Sep. No. 1, 1828 (1831).

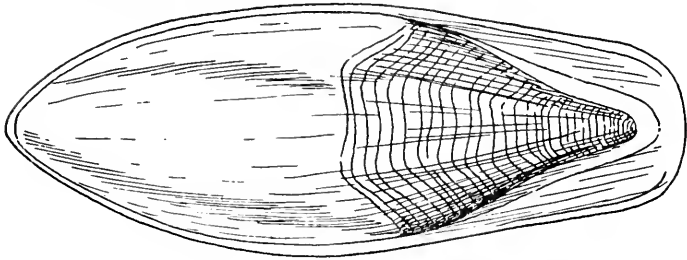
Sepia officinalis Linné

✓

Plate 145

TYPE: Linné's type locality is given as: "*Habitat in Oceano.*" He refers to the Muf. Ad. Fr. I, p. 93, Rondelet, 1554, and other early writers in natural history.

DISTRIBUTION: This species is widely distributed within the Mediterranean Sea, but is very rare on the northeast coast of Portugal.



Text figure 22.—*Sepia officinalis* Linné, ventral view of gladius, $\times 0.35$.

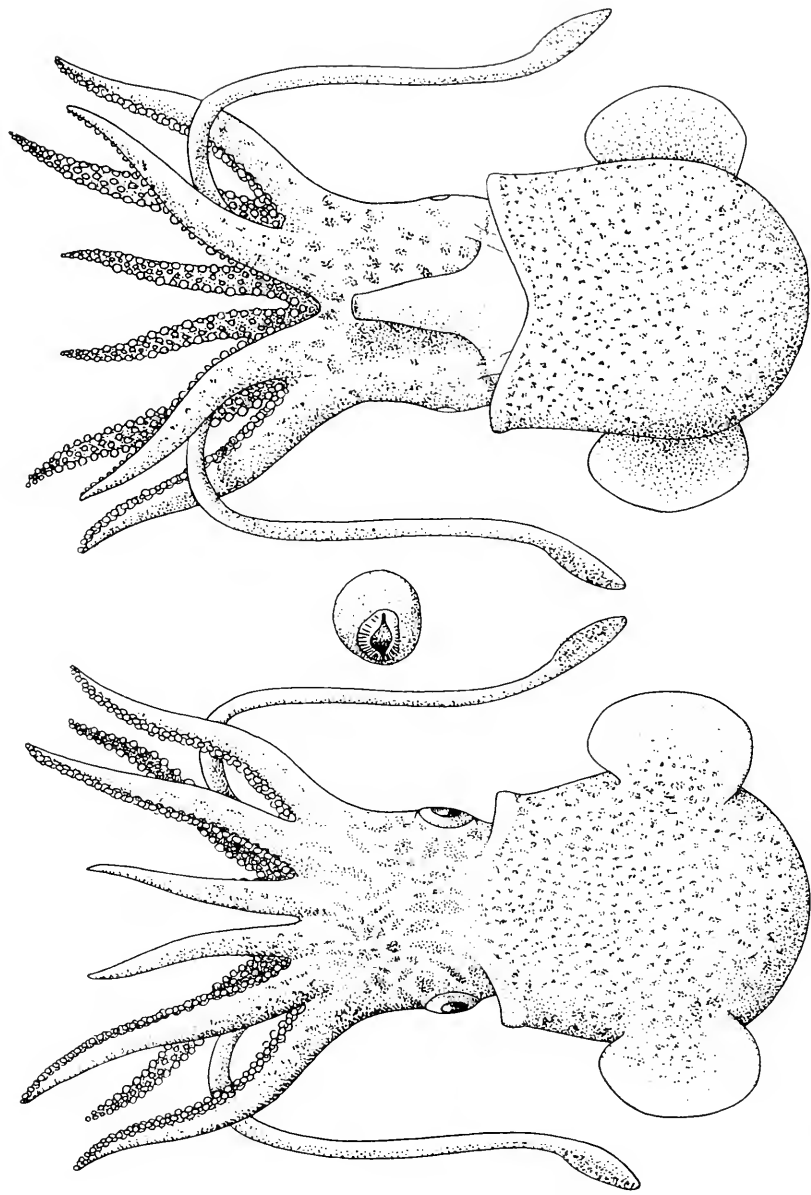
MATERIAL EXAMINED: One specimen from Naples, Italy.

TECHNICAL DESCRIPTION: This, the largest of the Mediterranean *Sepiæ*, attains a length of 14 to 16 inches. The present specimen, from Naples, has a total length of 15 inches. The body is smooth, depressed, wide-oval. The free mantle margin is produced to a wide blunt triangular point in the median dorsal area, on either side of which it is widely concave; on the ventral free mantle margin there is a wide excavation below the siphon. The fins are attached about 5 millimeters behind the anterior margin and extend the entire length of the lateral margin, gradually increasing in width posteriorly, attaining the maximum width about the posterior three-fourths of the body length. The exposed portion of the siphon is fairly large and extends almost to the base of the fourth pair of arms; it is muscular, conic, with a moderately wide aperture; the head is distinctly longer than wide, depressed, broad, with the orbits large.

The sessile arms are short, strong, unequal, decreasing in length in the order 4, 3, 2, 1. The suckers of the sessile arms are set in four series; the corneous ring of a cupule is smooth, devoid of denticles.

The tentacular arms are long, elastic, with about the distal fifth supporting the club, which is large, of oval contour and bears a ribbon-like web along the free lateral margin. The suckers are grouped in six alternating series, with about 4 to 6 cups in the central area enlarged, the other cups being smaller and closely crowded. The horny ring of these larger cups is smooth, while the ring of the smaller cups is dentate.

The shell is oblong-ovate, 2.6 times as long as wide, broadly lanceolate, devoid of cartilaginous margin, hard, white, faintly tinged with colour and closely corrugated dorsally, with a faint



Euprymna scolopes Berry, dorsal and ventral views $\times 2$, inset of a large sucker from sessile arm, much enlarged.

median ridge and slightly divergent depression on either side of this. The ventral surface has the posterior third of the shell excavate, marked by the successive transverse sinuate lines of growth. (See fig. 22).

The males are said to have a more oval body than do the females and to have their fins distinguished by a linear white margin.

COLOUR: Reference is made to Verany's exquisite colour plate 24 of this species. Characteristic colour form of this squid, which is subject to the usual colour change of *Sepiæ*, is a deep reddish purple with darker blackish purple transverse bands; some of which are branching with smallish white maculations interspersed; eye jewel-like.

EGGS: The egg capsules frequently occur in approximately a thousand per cluster. The embryos have been the subject of a very thorough study, made at the Naples Aquarium by Dr. A. Naef. The very young squid are eaten extensively by crustaceans and fishes.

REMARKS: This species is commercially important in the Mediterranean countries, not only as food, but for use in the extraction of the pigment *Sepiæ* from the ink-sac, and also for the making of an abrasive chalk-like powder, used as a base in modeling.

REFERENCES: *Sepia officinalis*, LINNE, C. VON., 1758, Syst. Nat. ed. X, p. 658.—VERANY, J. B., Cephalopodes de la Méditerranée, 1851, pp. 65-70, pl. 24 (colour).—NAEF, A., Fauna e Flora del Golfo di Napoli, publ. della Sta. Zool. di Napoli, Monogr. XXXV-a, Die Cephalopoden, Berlin, 1923, Text I, Bd. I, p. 547 and numerous illustrations (with exhaustive diagnosis and synonymy).—NOBRE, A., Moluscos Marinhos de Portugal Inst. de Zool. de Univ. d. Porto, 1931, p. 23, pl. 7, fig. 1 (with detailed distribution in Portuguese waters).

Family: SEPIOLIDÆ

Genus: EUPRYMNA Steenstrup

Euprymna scolopes Berry

✓

Plate 146

TYPE: The type series was taken by the United States Bureau of Fisheries Steamer "Albatross" at station 3905, surface, off

Kelaupapa, Molokia, Hawaiian Islands; the type is a male, deposited in the United States National Museum and the paratypes are in the private collection of Dr. S. S. Berry.

DISTRIBUTION: This species is known only from the Hawaiian Islands region, where it is one of the most abundant species of the cephalopod fauna, especially in shallow water and on the reefs; it has also been captured in dredge hauls ranging from the surface down to 141 fathoms. Fifty-four specimens were taken by the "Albatross" and ten by agents of the Leland Stanford University; these represent the only record for the species and are deposited in the United States National Museum, the Leland Stanford University collection and the private collection of Dr. S. S. Berry. The "Ara" specimens from Kewalo Bay add another locality for the species.

MATERIAL EXAMINED: Six specimens, taken from Kewalo Bay, Honolulu, Hawaiian Islands, 2 fathoms, December 17, 1928.

TECHNICAL DESCRIPTION: As pointed out by Dr. Berry, in his excellent description of the species, *Euprymna scolopes* is very close to *Sepiola stenodactyla* Grant (= *Euprymna stenodactyla* Grant), from Mauritius, also to *E. morsei* Verrill, from Japan, the principal differences being in the structure of the hectocotylized arm.

The largest of the "Ara" Hawaiian specimens measures 25 millimeters long in the median dorsal line, from the nuchal commissure to the posterior margin and is 20 millimeters wide across the anterior margin.

This pretty little squid is *Sepiolid* form, small and exceedingly active. The body is short, thick, widely convex posteriorly, the transverse diameter, measured slightly in advance of the fins, varying from four-fifths of the body length in large specimens to only two-thirds of the length in young ones; the thickness dorso-ventrad is 15 millimeters, measured about midway the body length. The semicircular fins are widest posteriorly and are attached decidedly obliquely, a little in advance of the middle of the body, their transverse diameter being about three-fifths of the long diameter; the anterior lobe is deeply incised and rounded at the inner angle so that only the posterior two-thirds of the fin is attached to the body.

The mantle is united with the head in the nuchal region by a broad commissure, 13 millimeters wide, on a specimen 20 milli-

meters in diameter, so that the pallial aperture extends dorsad only a very brief distance beyond the eye-ball which it partially encompasses posteriorly. Ventrally the mantle margin is sinuous, being concave in variable degree beneath the funnel and convexly advanced on either side of this.

The head is 80 to 90 per centum as long as wide, quite flattish dorsally and somewhat excavate ventrally beneath the siphon. The eye is large, conspicuous, tumid. The funnel is elongate, conical, the apical portion cylindrical, nearly or quite extending to the bases of the fourth pair of arms, with the apical aperture small, the siphon wall thick, interior of the apex minutely striate longitudinally, the small valve is spoon-shape, located on the dorsal wall immediately posterior to this striate area and in turn is followed posteriorly by an area of strong transverse striation. The funnel organ is posterior in position.

The arms are rather stocky, about as long or slightly longer than the body and of unequal lengths, the arms decreasing in the order 2, 3, 4, 1, the inequality between the dorsal and ventral pairs being slight and the second pair normally exceeding the third pair by a very short distance. There is a fugitive external carina of skin present on pairs one, two and three, this attaining highest development on the third pair of arms; the fourth pair are externally rounded. The interbrachial web is very rudimentary between the arms of the dorsal pair as well as of the ventral pair, being somewhat deeper between the arms of the first and second pairs, while between the third arm and related fourth one the web is characteristically developed, supporting the base of the tentacular arm. The suckers on all four pairs of sessile arms are close-set in dual series proximally for about the first two or three pairs, beyond which these pairs are displaced alternately so that four rows exist, closely crowded, with the suckers set on stout, flexible, conical pedicels, the cups subspherical, with a distinct indentation near their attachment to the pedicel. The chitinous ring within the sucker is prominent, subcircular, frequently convexly produced unequally in the larger suckers and having an oval or elliptical lip-like small aperture. The ring appears devoid of teeth but under high magnification is seen to be cut into an irregular crenulation or rudimentary dentition on the deeper side of the larger suckers of the ring, but smooth in the smaller cups.

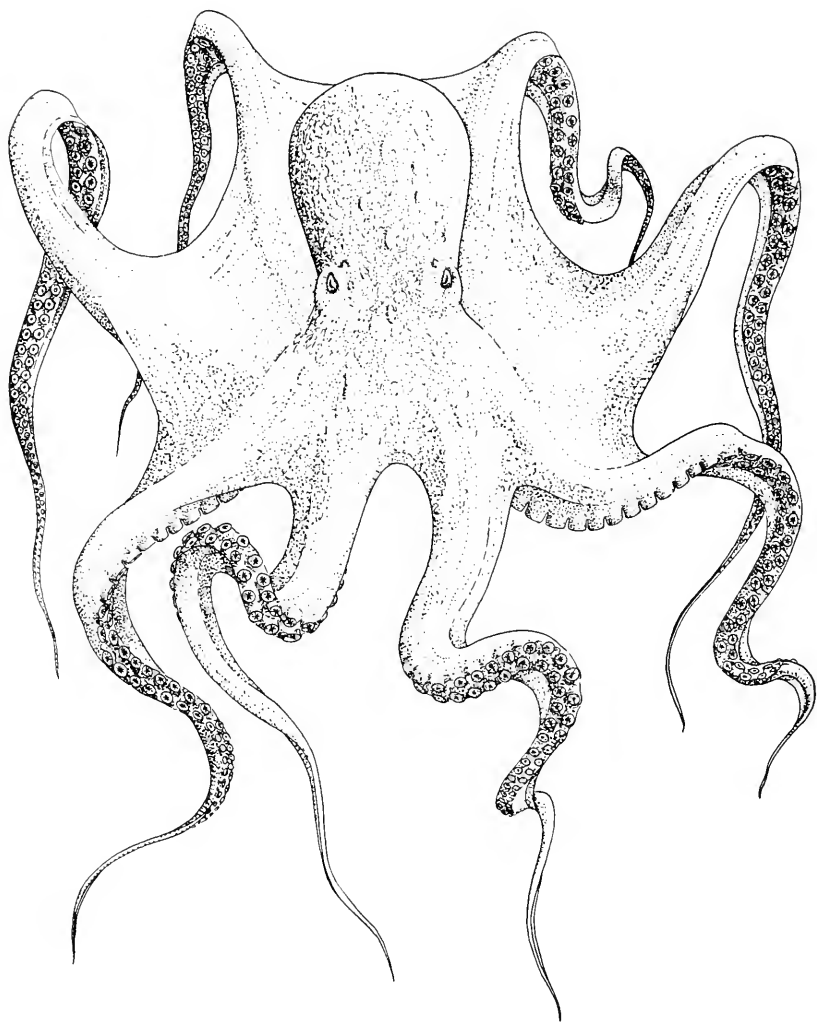
The left dorsal arm of the male is hectocotylized. This arm is

much dilated beyond the basal third. The proximal four pairs of suckers are in two rows, these being succeeded by the four-row arrangement, in which the series contains two modified papillae, these being slenderer and more obliquely placed than the ordinary pedicels. These are succeeded by about ten four-row series, the suckers of which are globular, like those of the female, except that the dorsal series are larger. Beyond the basal third the arm is much enlarged, the two ventral rows of suckers are abruptly replaced by a closely crowded, irregular series of specialized papillae which are large, transversely elongate and compressed, with a large mouth-like or slit-like aperture, the horny ring showing on the opposed outer half and bearing a continuous series of ten to twelve small jagged triangular teeth, while the inner half is produced forward over the aperture, in the form of a wide convex, marginally rounded process, lip-like, with the free rounded margin separated by only a narrowed crescentic aperture. Above and overarching but distinct from this chitinous lip is the fleshy, thick, rounded opposite "upper lip" of the papilla. The suckers of the two dorsal series continue unspecialized for two or three pairs beyond the point at which the ventral one becomes specialized, when the dorsal series of suckers also becomes modified, forming a crowded alternating double series of dilated tubercles, but having the pedicels not transversely compressed and not so closely crowded together as are the vertical series.

The right dorsal arm is slenderer than the left and more nearly resembles the female arm than do any of the others of the series. The suckers are small, closely crowded, especially in the median rows, and the ventral row of suckers are smaller than the dorsal series.

The second pair of arms have the suckers comprising the outer rows definitely larger than those of the inner series, four to six of the proximal suckers of the dorsal series being distinctly larger than the remainder of this series; in the ventral series on the distal two-thirds of the arm there are seven or eight suckers, much enlarged, occurring in alternation with the small suckers of about one-third the diameter.

The third pair of arms also have the suckers of the two marginal series larger than those of the two inner series, with eight to ten alternately placed suckers of the distal portion of the vertical series enlarged. The fourth pair of arms have a similar but



Octopus (Octopus) rugosus (Bosc), about one-third of natural size.

slightly less conspicuous development of suckers, with three to four alternating suckers of the dorsal series moderately enlarged.

The tentacular arms are very elastic, slender, long, laterally compressed, keeled near the distal end, with the inner surface flattened; the club is expanded but little, recurved and with the tip coiled upon itself; the inner surface appears villous, due to closely packed series of numerous minute suckers. The separate suckers are slightly oblique, deeply urceolate, with the papillary area quite wide and the inner aperture decidedly reduced. The pedicels are quite long, proximally columnar and closely crowded, so that the suckers are mobile because of a shorter constricted peduncle, about one-fifth as long as the proximal stalk and less than one-fourth as wide, which unites the stalk and cupules.

The buccal membrane is produced into seven points and is thickened, with the margins plaited.

There is no pen in this species.

The chromatophores make a very distinctive pattern of large, transversely elongate chromatophores in close series along the outer aspect of each sessile arm and a similar series of small chromatophores along the distal outer portion of the tentacular arms; the dorsal and ventral surfaces of the mantle are maculated with numerous brownish dots.

REFERENCES: *Euprymna scolopes*, BERRY, S. S., Proc. U. S. Nat. Mus., 1913, vol. XLV, p. 564; Bull. U. S. Bur. Fish. for 1912 (issued 1914), vol. XXXII, Doc. 789, p. 312, pl. 49, figs. 5-8, text figs. 23-26.

Order: **OCTOPODA**

Suborder: **Incirrata**

Family: **OCTOPODINAE**

Subfamily: **Octopodinae**

Genus: **OCTOPUS** Lamarck

Subgenus: **Octopus** d'Orbigny

Octopus (Octopus) rugosus (Bosc)

✓

Plate 147

TYPE: Bosc's type is not traceable.

DISTRIBUTION: Usually shallow water, there being only one or two deep water records. The authentic records of the distribu-

tion of this species appear to establish it from the northeastern Atlantic, from west Africa, Sierra Leone, the Canary Islands, the Mediterranean Sea, the Red Sea, East and South Africa, the Indian Seas, Malaysia, northward to China and Japan, and eastward to Hawaii and southward to Australia. Some records of it from the western Atlantic have been made but the present writer's familiarity with this faunal region convinces one that such records for *O. rugosus* are open to suspicion and likely to be proven to be *O. vulgaris*. Similarly Dr. Hoyle's record (1904) of *rugosus* from Galapagos, as *occidentalis*, is probably referable to *O. bimaculatus* Verrill, well known to the writer, from San Diego, California, to Panama, also in the Galapagos Archipelago.

MATERIAL EXAMINED: An extensive series, ranging from specimens with an umbrella of less than one inch, to one with a diameter of over seven feet, was taken by the "Alva," as follows: Cat. No. 830, one large specimen, with head cut off, Anaho Bay, Nuka Hiva Island, Marquesas Islands; Cat. No. 831, another complete specimen, from the same locality; Cat. No. 832, one very large specimen, from the same locality; Cat. No. 833, one specimen, from the same locality; Cat. No. 834, one specimen, from Venus Point Reef, Tahiti, Society Islands, August 15, 1931; Cat. No. 837, a young specimen, from Venus Point Reef; Cat. No. 835, one young specimen, from Teviatoa Reef, Raiatea Island, Society Islands, August 21, 1931; Cat. No. 836, another young specimen, from Raiatea Island; Cat. No. 843, from the same locality; Cat. No. 838, one specimen, from Seba-Seba Bay, Durian Straits, Dutch East Indies, October, 1931; Cat. No. 839, one fairly large specimen, from Southport, Queensland, Australia, November, 1931.

LIFE HISTORY: This species has not been bred in captivity nor critically studied at seaside laboratories, so far as published records are available. It is believed to be the species known to have deposited its eggs inside the shells of empty pearl oysters and of another mollusk, *Mytilus* species, in the Gulf of Manaar (W. E. Hoyle). *Octopus rugosus* is a shallow-water species, making its den in the crevices of coral reefs and among rocks.

TECHNICAL DESCRIPTION: The specimen, dead and considerably shrunken, has a web diameter of 7.11 inches, measured from tip to tip of opposite arms. The body is of the usual saccular type, being a little more than one-fourth longer than wide. The head is slightly narrower than the body; the eyes are moderately promi-

ment. The web is bilaterally symmetrical, well developed, uniting the proximal region of the arms for a distance not quite equivalent to one-fourth of the arm length. The arms in the "Alva" series of specimens are in the order 2, 3, 4, 1, except in the largest two specimens, where it is 3, 2, 4, 1, the third and second pairs here being nearly equal.

The suckers are quite large, set closely in alternate series. The largest suckers occur in the sixth to tenth series of the second and third pairs of arms, where in the largest specimens they attain a diameter of fourteen per centum of the mantle length, while in smaller specimens the ratio is only ten per centum. The individual suckers are large, circular, with a deep central pit, saucer-like, with strong, fine radiating grooves and the margin distinctly expanded in two borders.

The mantle aperture is quite wide, the funnel free for half its length, well developed, with the locking ridge continuous from side to side in all but two specimens. The funnel organ varies in shape, being a complete W-shape, or incomplete, having the outer arms of the W shorter than the central portion, or *vice versa*. Seven to eleven filaments are to be found in each demibranch.

The radula are variable, the rachidian tooth being constantly symmetrical, each series consisting of three to five teeth, but showing variation in the type of periation.

The hectocotylus of the male is said by Robson (1928) to possess considerable variation. The one male present in the collection from the Society Islands has the calamus near the last sucker and is typical. In the large females the oviducal gland was moderately large, in one specimen being considerably dilated.

The texture of the skin is coarse, variously roughened with pointed granules, knob-like verrucae, or grouped small verrucae around a central knob, the degree and kind of markings undoubtedly being due to state of preservation and mode of killing which the specimen has undergone. The general colour of the present *dead* specimen is deep gray to purplish black dorsally with paler suckers in conspicuous contrast on the ventral side. Cirrhi are usually present about the eyes and sometimes on the dorsal of the body.

VARIETIES: For discussion of the numerous varieties of the species, consult Robson (1929).

REFERENCES: *Sepia rugosa*, BOSC, L., Actes Soc. Hist. Nat. Paris, 1792, t. I, p. 24, pl. 5, figs. 1, 2.—*Octopus (Octopus) Rugosus* ROBSON, G. C., Monogr. Recent Cephalop. Coll. Brit. Mus., pt. I, 1929, p. 63, pl. 2, fig. 3, text figs. 8-9 (with full synonymy).

Octopus (Octopus) horridus d'Orbigny, Audouin and Savigny

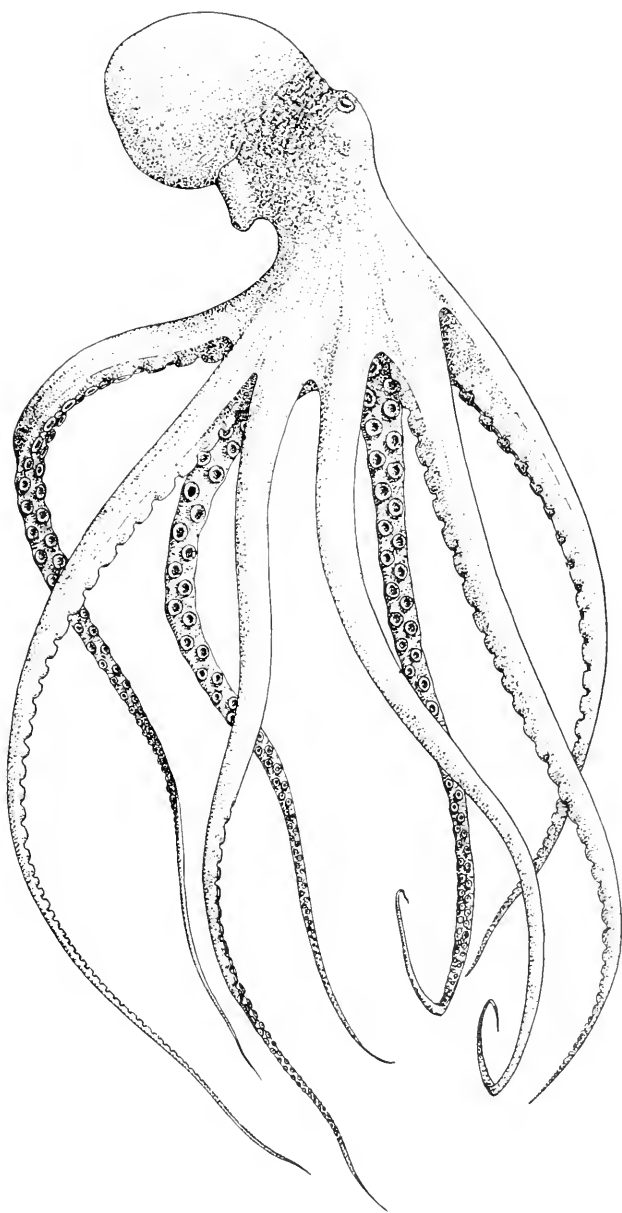
Plate 148

TYPE: The type of this species has a curious history. Collected by the French Governmental Expedition into Egypt, it was first figured by M. Savigny in his exquisite plates, illustrating the "Exploration de l'Egypte," "explication" of which by M. Audouin was published in 1826 (exact date of issue not traceable). Meanwhile, M. d'Orbigny described the species, apparently basing his description on the unpublished Savigny illustration; this description was published in January or February, 1826. This specimen figured by Audouin and Savigny, so labeled, is deposited in the Senckenberg Institute, Frankfurt, Germany, but bears also the confusing designation of type of *Octopus fimbriatus* Ruppell, Mss. name, used by d'Orbigny for an octopus apparently from the Red Sea, which was reported and described in a letter sent him by de Haan.

DISTRIBUTION: Originally described from the Red Sea (d'Orbigny, Audouin, Savigny) and Egyptian coast, this species, which is preeminently an inhabitant of the shallow-water reefs and coral crevices, is abundant and widely distributed in the west and central Indian Ocean, having been recorded repeatedly from the Suez Canal, Red Sea, Egyptian coast (Gray, Weindl, Wulker); Kor Dongala, Suakim, Zanzibar (Hoyle); South Africa (Krauss); Indian Ocean, Amirante Island (Robson); Hulule and Male Atoll, Maldive Archipelago (Hoyle); and Ceylon (Hoyle, Winckworth).

MATERIAL EXAMINED: Two small specimens, collected in the Red Sea, at Makawa Islands, by the "Ara," March 12, 1929.

TECHNICAL DESCRIPTION: The body of this species is of variable shape, frequently being pyriform, with a subconical apex and sometimes of a distinctly quadrate-ovoid appearance. The head is not very distinctly separated. The mantle aperture is narrow. There are about six filaments in each demibranch. The funnel is



Octopus (Octopus) horridus d'Orbigny, Audouin and Savigny, reduced,
from Makawa Islands, Red Sea.

conical, attached for about 6.5 of its length, with a W-shaped funnel organ. The pallial septum is short, being equivalent to nearly 0.2 of the mantle length. The web is usually shallow, not exceeding 0.15 of the arm length, of variable shape, the dorsal and next to dorsal paired sectors being shallowest, while the remaining sectors are deeper and approximately subequal. The arms are quite long, being 0.80 to 0.85 of the total length, with the fourth or ventral pair regularly the longest, the series usually decreasing in the order 4, 3, 2, 1, but in some instances being 3, 4, 2, 1. The suckers are moderately large and not crowded. The hectocotylized arm is nearly a third shorter than its companion. The ligula is small, about 0.4 of the related arm length, tapered, with a narrow, deep, longitudinal ligular groove and a decided transverse, obliquely curved groove proximal to the calamus.

COLOUR: This octopus is a most unfortunate victim of M. d'Orbigny's inappropriate specific name; when seen in its own environment, the tropic shallows of the Red Sea and adjacent regions, this graceful, gaily coloured creature has a unique, eerie, gnomish beauty, as it glides among the rock crevices. It has a very distinctive colour pattern, usually being of a reddish-magenta-purple ground colour, reticulated with large circular to oval white spots, in the center of each of which the octopus may erect a cirrhus; if attacked, or if seeking to frighten prey, waves of colour, like blushes, pass over the body, so that the ground colour is thus deepened and lighter tones of reddish-purple transiently tint the creamy spots.

REFERENCES: *Octopus horridus*, D'ORBIGNY, A., et FERUSSAC, A., DE, Tabl. Meth. de la Classe des Céphal., Ann. Sci. Nat. ser. I, t. VII, 1826, p. 144.—AUDOUIN, J. V., et SAVIGNY, J., Descriptive de Egypte, etc., Hist. Nat., 1826, t. I, p. 10, pl. 1, fig. 2.—ROBSON, G. C., Monogr. Recent Cephalop. Brit. Mus. Coll., pt. I, 1929, p. 91, text figs. 18-19 (with full synonymy).

Octopus (*Octopus*) *cyanea* Gray

Plate 149

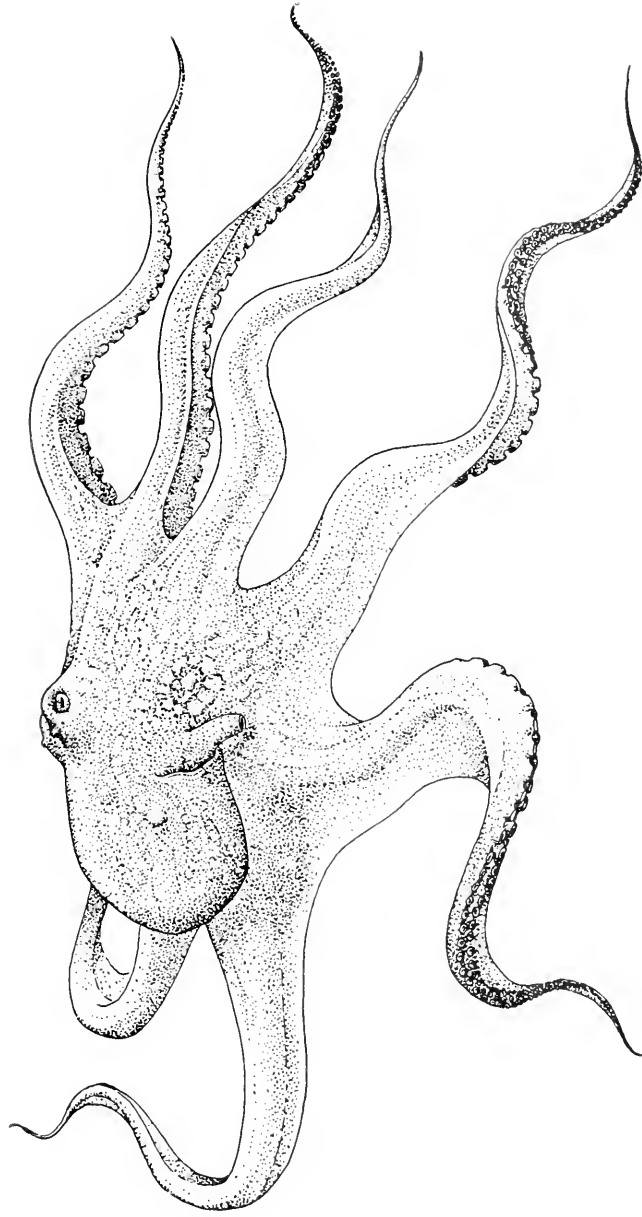
TYPE: Gray's type is a male specimen, from the coasts of New Holland (Australia), deposited in the British Museum of Natural History.

DISTRIBUTION: This strikingly coloured littoral octopus has a wide distribution, having been recorded from the Red Sea (Ruppell, Wulker); Suakim (Hoyle); Djeddah (Joubin); Zanzibar, Seychelles, Mauritius (Hoyle); Australia (Gray, Brazier); Ak-yab, Burma (Massy); Madras (Robson); Coetivy Atoll, Indian Ocean (Robson); Ceylon (Ortman); Amboina (Joubin); Rimatara, Austral Isles, Buka and Stewart Isles, Solomon Isles (Wulker); Rotuma and Fiji (Hoyle); Christmas Island (Robson); and Hawaiian Islands: Honolulu Reefs, Oahu and Hilo (Hoyle, Berry, Robson, Boone).

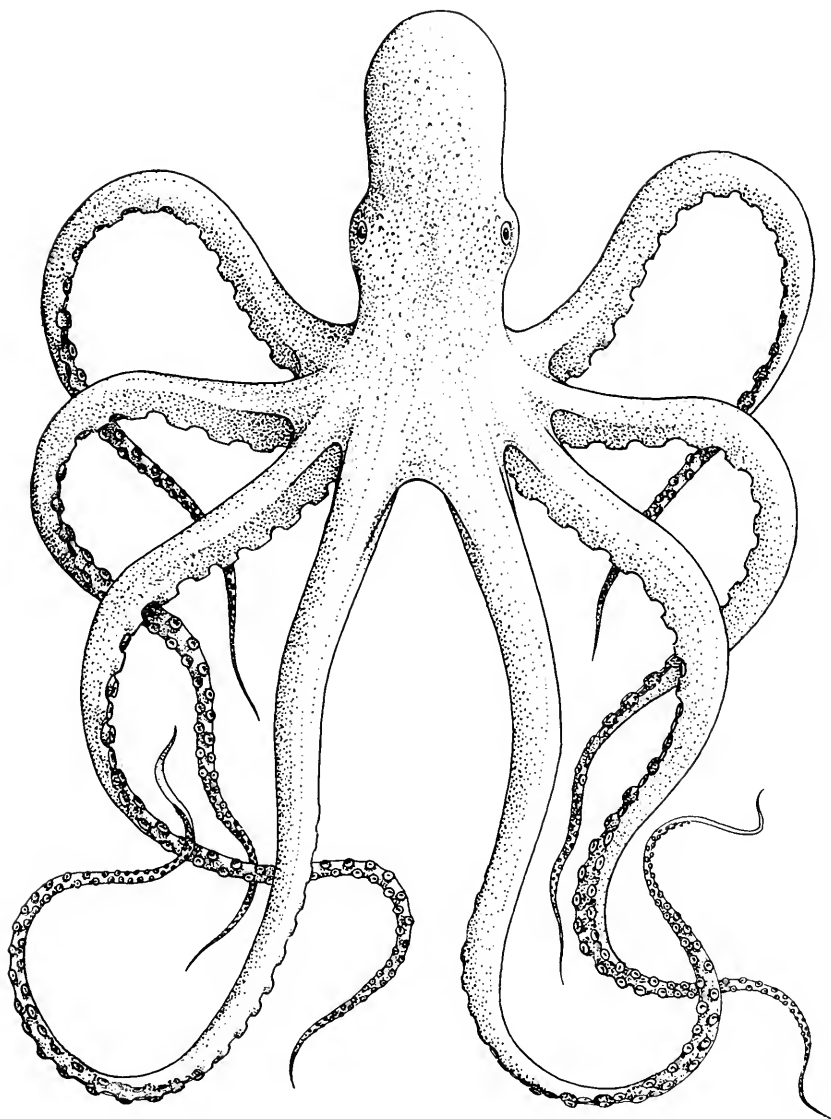
MATERIAL EXAMINED: One female, taken in 2 fathoms, at Hilo, Hawaii, December 11, 1929, by the "Ara."

TECHNICAL DESCRIPTION: This octopus has been very thoroughly described by a number of writers. Reference is especially made here to the recent very thorough discussion of *Octopus cyanea*, presented by Mr. Robson (1929, p. 94, figs. 21-23), based upon an extensive series of specimens from widely separated localities and to that of the late Dr. W. E. Hoyle (1885, p. 227; *ibid*, 1886, p. 85, pl. 6, colour), who first described Hawaiian specimens of *O. cyanea* under the name of *O. marmoratus*, this species name having reference to the colour pattern of ochreous red maculated with purple and series of intercotyledonary colour bands down the surface of the arms of this octopus. Reference is also made to the excellent report of Dr. S. Stillman Berry (1909, p. 418, also 1914, p. 291, pls. 45 and 46, figs. 6-11) on the "Albatross" collection of "Cephalopoda of the Hawaiian Islands."

The "Ara" specimen is a female, which in the dead and somewhat shrunken state, has a web diameter of 20 centimeters. The body is rounded pyriform with a smallish head; the mantle aperture is of medium width; the web is widest laterally, with the dorsal sector deeper than the ventral; the arms, of which the left one is bitten off and another arm partly regenerated, are long,



Octopus (Octopus) cyanea Gray, about one-third of natural size, from Hilo, Hawaii.



Octopus (Octopus) macropus Risso, about natural size, from Jebwar, Jaluit Island, Marshall Islands.

about 80 percentum of the total length and are nearly subequal, decreasing in the order 4, 3, 1, 2, by about 0.5 centimeter difference between the pairs. The skin is smooth in relaxed portions but has a rough, somewhat scaly appearance in the wrinkled (death-contorted) areas; there is also a large supra-ocular cirrus with four or five supplementary tubercles adjacent. There are also numerous dorsal tubercles present in various stages of distortion. There is a distinctive ocellus present on the dorsad of the web between the bases of the third and fourth arms and the eye; this ocellus has a long diameter equal to about one-sixth of the mantle and consists of an ovate dark purple eye-spot margined by a paler ring, which in turn is margined by a narrow dark purple line.

REFERENCES: *Octopus cyanea*, GRAY, J. E., Catal. Mollusca Brit. Mus. N. H., pt. I, 1849, p. 15.—ROBSON, G. C., Monogr. Recent Cephal. Brit. Mus. N. H., pt. I, 1929, p. 94, text figs. 21-23 (with extensive synonymy).

Octopus marmoratus, HOYLE, W. E., Ann. Mag. Nat. Hist. ser. 5, vol. XV, p. 227; Rept. H. M. S. "Challenger" Zool., 1886, vol. XVI, p. 85, pl. 6.

Polypus marmoratus, BERRY, S. S., Proc. U. S. Nat. Mus., 1909, vol. XXXVII, p. 418; Bull. U. S. Bur. Fish., 1912 (issued 1914), vol. XXXII, p. 291, pls. 45, 48, fig. 6.

Octopus (Octopus) macropus Risso

✓

Plate 150

TYPE: Risso's type was collected along the northern shores of the Mediterranean Sea and is deposited in the Municipal Museum at Nice.

DISTRIBUTION: The bathymetric occurrence of this species is from the tide line down to 100 fathoms. Geographically it ranges from the Mediterranean (the type locality; Risso, Verany, Jatta, Lo Bianco, Robson); Naples, Messina (Robson); into the adjacent waters of the northeast Atlantic (Joubin, Girard); Lanzarote, Canary Islands (Robson); the Red Sea (Wulker, Robson); East

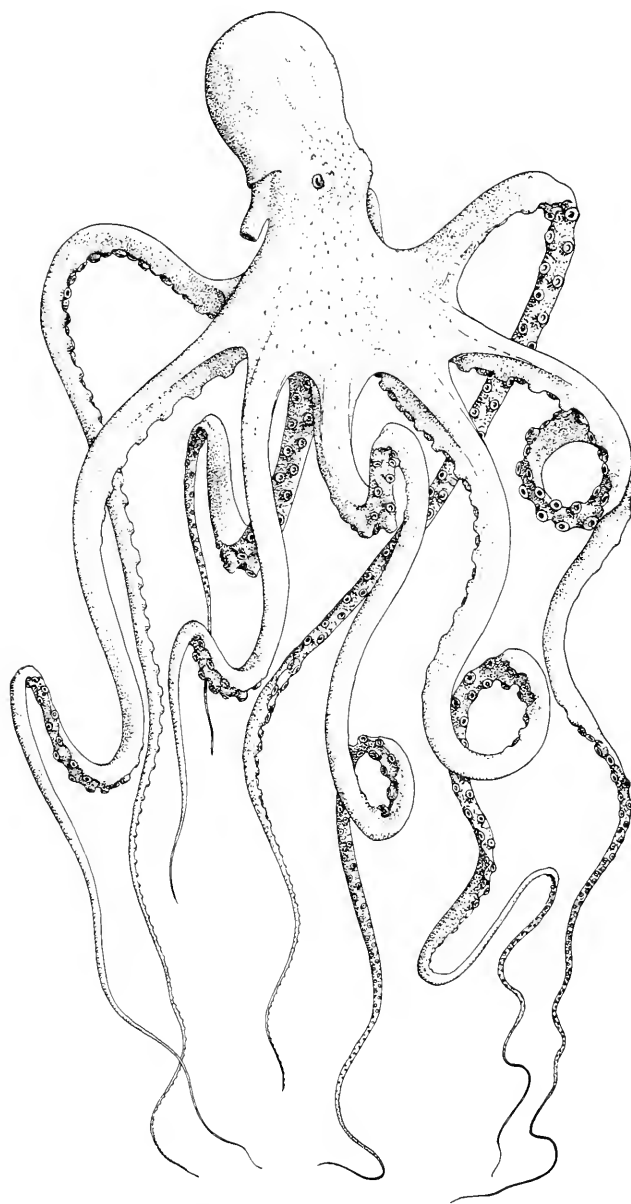
Africa (Joubin); Mauritius (Robson); Persian Gulf (Massy); Ceylon, Pondicherry (Robson); Malaysia (Brock); Aru Islands (Wulker); Gulf of Siam (Massy); Penang, China, also Chusan Archipelago (Robson); Japan (Joubin, Ortmann, Robson); Marshall Islands, western Pacific (Hoyle, Robson, Boone).

MATERIAL EXAMINED: One specimen, taken at Jebwar, Jaluit Island, Marshall Islands, December 30, 1928, by the "Ara."

TECHNICAL DESCRIPTION: Reference is made to the excellent description of this species by Robson (1929, p. 104, figs. 27-30) in his classical "Monograph of the Recent Cephalopoda, based on the collections in the British Museum of Natural History." Mr. Robson has probably had access to the most comprehensive series of specimens reported.

The present specimen, a male, is especially interesting, as it establishes another record for the species from the Marshall Islands, from which locality it was first recorded by Dr. Hoyle (1907), with some uncertainty, since his specimen was juvenile, of not quite 10 centimeters total length; a second record of a male from the Marshall Islands was reported by Mr. Robson.

The "Ara" specimen, a male, has a total length of 20 centimeters. The mantle is of the characteristic slender, ovoidal shape, with the head smallish, of diameter somewhat less than that of the body. The arms decrease in the order 1, 2, 3, 4, being from 80 to 85 percentum of the total length, the first pair of arms being longer and somewhat thicker than the others; the hectocotylized arm is definitely shorter than its companion. The suckers are arranged in regularly spaced, alternate dual series, each sucker having a diameter slightly more than one-half of the width of the arm at the point where the sucker occurs. The mantle cavity is quite wide, extending to a point on either side just posterior to the orbit. The web is distinctly characteristic, attaining a depth of from 15 to 20 percentum of the related arm length, the greatest depths of web occurring between the arms of pair I and pairs I and II, becoming gradually shallower between pairs II and III, again decreasing between pairs III and IV and of least depth between the arms of pair IV. The arm membranes are not much developed. The funnel is prominent, obconic, free for about the distal half. The locking ridge is strong, but incised by a deep infundibular notch. The funnel organ is W-shaped. There are twelve filaments in each half. The beak has been figured by Naef (1923, pl. 18,



Octopus (Octopus) ornatus Gould, greatly reduced, from the Island of Oahu, Hawaii.

fig. 6) ; the rachidian teeth have been described by Robson (1929, p. 104) and the pallial stylets figured by Jatta (1896, pl. 24, fig. 13b).

The reproductive organs have been figured by Naef (1.c., fig. 405; Marchard 1907, p. 363, and Robson 1.c., figs. 28, 29, 30).

The living octopus is brown splashed with red markings (d'Orbigny and other authors). The texture of the skin is naturally a fine shagreen, consisting of pointed granules which may be augmented by low, rough verrucae. Though difficult to translate in words, one familiar with *Octopus macropus* readily appreciates the nuances of delicate sculpturing that distinguish this octopus from *O. vulgaris* Linné, which has a similar distribution, in part.

The largest representative of *Octopus macropus* recorded is a Mediterranean specimen which weighed 1.6 kilograms and had a total measure of 1.5 meters.

REFERENCES: *Octopus macropus*, RISSO, A., Hist. Nat. Europe Meridionale . . . Paris, 1826, t. IV, p. 3.—JATTA, G., Fauna u. Flora d. Golfes von Neapel Monogr. XXIII, 1896, p. 217, pls. 6, 23 and 24.—MARCHAND, W., Studien uber Cephalopoden I. C. Wiss. Zool., Leipzig, 1907, p. 362.—NAEF, A., Fauna e Flora del Golfo di Napoli Monogr. XXXV, Die Cephalopoden, 1923, I Th. Bd. I, lief 2, p. 702.—ROBSON, G. C., Monogr. Recent Cephalop. of Brit. Mus. N. H., pt. I, 1929, p. 101, figs. 27-30 (with extensive synonymy).

Octopus (Octopus) ornatus Gould

✓

Plate 151

TYPE: The type of this species was collected by the United States Exploring Expedition at Oahu and Maui, in the Sandwich Islands (Gould). It is deposited in the United States National Museum and, when examined by the writer in 1921, had deteriorated through neglect to such extent as to be scarcely recognizable. The "Albatross" material of this species, also deposited there, had fared no better.

DISTRIBUTION: This species is restricted to the littoral waters of the Hawaiian Islands, there being but three published records

of the octopus, i. e., the two cited by Mr. Gould and one by Dr. S. S. Berry (1914), of two males, taken on Honolulu Reef, Oahu, and one male, purchased in Honolulu Market. The "Ara" specimen is also from Oahu.

MATERIAL EXAMINED: One large male, taken on the Island of Oahu, Hawaii, December, 1928, by the "Ara" World Cruise.

COLOUR: The present specimen retains, in considerable degree, the characteristic colour pattern of the species, so beautifully portrayed by Mr. J. Drayton, artist, under the direction of Mr. J. P. Couthouy, naturalist, of the United States Exploring Expedition. Mr. Gould described the colour of the living animal as follows: "The surface is coarsely reticulate-papillose, with a series of oblong-oval, smooth and colourless patches along the back of the arms and around the sac, somewhat resembling bullae. The ground colour is deep orange; beneath somewhat clouded with white; above variegated with five longitudinal, buff stripes, the median one extending to between the eyes, the two lateral ones curving on each side, like meridian lines and extending only to the neck; between these lines, around the middle of the sac, are deep brown patches, and also between the bases of the arms; there are also brown mottlings along the back of the arms. These, with the pale, bubble-like patches around the base of the sac, and along the arms, give a very gay and diversified colouring."

The "Ara" specimen, an adult male, has a total length of 675 millimeters. The body is of medium size, globose, more expanded and rounded posteriorly, attaining the maximum width slightly posterior to the middle. The mantle aperture is moderately wide, extending about .55 of the total distance between the orbits. The head is definitely narrower than the body, from which it is separated by a distinct nuchal band. The funnel is long, conic, tapering, and extends for about .65 of the distance from the mantle aperture to the web margin, being attached for half its length, the funnel aperture is small, the funnel organ is W-shaped, the median process being twice as long as the lateral processes. The eyes are prominent, of moderate size. There are three, blunt, supraorbital cirrhi present above each eye.

The arms decrease in length in the order 1, 2, 3, 4, the degrees of difference being that shown in plate 151. The extreme length, slenderness and degree of marked attenuation of the arms, is one of the most striking characteristics of this species. The dorsal, or

first pair of arms, are distinctly the strongest and stoutest pair, being about 6.75 times as great as the combined length of the head and body and very attenuate; the second and third pairs of arms decrease gradually in length, the fourth, or ventral pair, being only 0.65 as long as the first pair. The suckers are discoidal, of moderate size, set in alternate dual series, somewhat crowded, the cupules deep; the largest suckers occur on the arm, a short distance beyond the web margin, and are of a diameter equal to about one-half of the arm diameter at this point. On the attenuated distal portion of the arms, these suckers are numerous, quite small, but strong. The hectocotylized arm is only 0.65 as long as its companion. The terminal organ is about 0.4 of the arm length. The ligula is an elongate-conic, conspicuously thickened and expanded, spoon-shaped article, with the inner surface moderately, widely excavate and marked with about ten irregular, transverse *laminae copulatoriae*.

The web is brief, attaining the maximum depth between the arms of the first pair, the sections between the first and second pairs of arms being nearly equal thereto, the third and fourth sections of the web gradually decreasing in depth, while the fifth section of the web, between the arms of the fourth pair, is quite shallow.

The texture of the skin is generally smooth on the ventral surfaces, but is very coarsely and irregularly papillose on the dorsal surfaces, these papillae frequently assuming the arrangement of longitudinal lines, frequently forming conspicuous ridges, especially on the body and web, adding to the grotesquerie of the octopus' appearance, especially when the creature is in a pugnacious state.

REFERENCES: *Octopus ornatus*, GOULD, A. A., in Wilkes, C., United States Explor. Exped., Mollusca, 1852, vol. XII, p. 476, pl. 48, figs. 590 and 590a, atlas, vol. XII. — TRYON, G. W., Man. Conch. 1879, vol. I, p. 112, pl. 30, figs. 29, 30.—ROBSON, G. C. R., Monogr. Recent Cephalop. Coll. Brit. Mus. Nat. Hist., pt. I, Octopodidae, 1929, p. 198.

Polypus ornatus, BERRY, S. S., Proc. U. S. Nat. Mus., 1909, vol. VII, p. 418; Bull. U. S. Bur. Fish., vol. XXXII, 1914, p. 294, pl. 46, text fig. 14.

Subfamily: **Bathypolypodinae**Genus: **BATHYPOLYPUS** Grimpe**Bathypolypus arcticus** (Prosch)

1

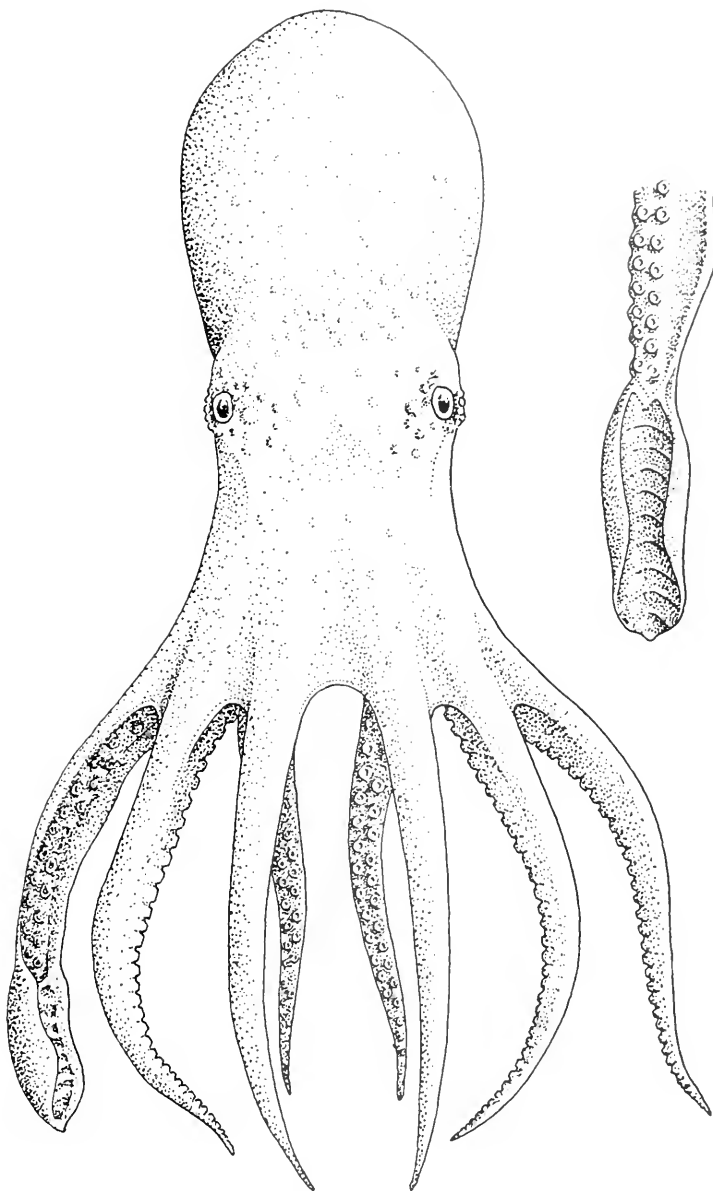
Plate 152

TYPE: This is a female specimen, labeled "Gronland M. R. Jorgensen, 27.7, 1840," deposited in the Zoologisk Museum, Copenhagen.

DISTRIBUTION: The bathymetrical occurrence of this species is from shallow water down to a maximum depth of 843 fathoms (Verrill). The average depth at which it has been more frequently recorded is about 200 fathoms. All records available tend to show that this is a species of the margin of the continental shelf and upper areas of the continental slope. Geographically it ranges in Arctic waters of north and northwestern Europe eastwards to the Murman coast, not having been found by the several expeditions which have explored the Barents Sea, Franz Joseph Land. On the American side, the only record of it west and north of Davis Straits is the one from Point Barrow, Alaska, given by Dr. Wm. H. Dall, which I think is correct. The lack of published record of this species in collections from the American and Alaskan Arctic is due to the deplorable condition existent in the United States Government Cephalopod Collections deposited in the National Museum. In European waters the southernmost records appear to be those from the coasts of southwest Ireland, while along the American continental shelf, the coasts of South Carolina and Georgia have hitherto been considered the southernmost records. The "Alva" specimens, dredged in 100 to 200 fathoms, off Fowey Rocks, Florida, extend the southern range on the American side. For detailed citation of distribution localities, consult Mr. Robson (1929).

MATERIAL EXAMINED: A male and a female, the exact label for which reads: Dredged March 29, 1935, station A, Dredged Fowey Rocks, Florida, bearing 289° true, 4.0 miles distant, 200 fathoms. Dredging with Fowey Rocks, bearing 273° true, 2.5 miles distant, 100 fathoms. Yacht "Alva."

TECHNICAL DESCRIPTION: The male is the larger of the two specimens taken. It measures 95 millimeters over all, while the



Bathypolypus arcticus (Prosch), male, $\times 2$, from off Fowey Rocks, Florida, in 100 to 200 fathoms; inset: ventral view of hectocotylized arm $\times 2.8$.

female measures 73 millimeters over all. The male body is ovoid or globose, measuring 29 millimeters long to the margin and 23 millimeters maximum transverse width. The head is slightly narrower than the body in the male, but in the smaller female the head is about as wide as the maximum width of the body, which is more tapered distally and less globular.

The mantle aperture is posterior to the eye on either side, by a distance equal to one-half of the aperture width. The mantle aperture is 17 millimeters wide in the male, where the total width is 22 millimeters. The funnel organ is comparatively short, that of the male being 4.5 millimeters long, attached for 3.5 millimeters, and about 4 millimeters wide, while in the smaller female the funnel organ is 6 millimeters long, attached for 5 millimeters, very slender and tapered distally. The funnel organ is W-shaped.

The gills have an average of eight filaments. The gill surface is very small. The inner demibranch is distinctly reduced, with the longest filaments about one-fourth less than the total depth.

The web is moderately developed, the first four sectors being approximately subequal, while the hindermost sector is slightly shorter than the others. The web has a depth of a little more than 0.35 of the arm length and is continued upon the arms for only a little distance.

The arms decrease in the order 1, 2, 3, 4, the first and second pairs being subequal; the third and fourth pairs, successively decreasing very little, being rather short. The suckers are very small, being of a diameter of 1.2 millimeters on those suckers located about opposite the web margin. The male hectocotylized arm is shown in plate 152, inset figure.

The male reproductive organs agree essentially with Prosch's description and figure (1849) of these. The oviducts of this female contain eggs.

The radula agree quite well with the typical *Bathypolypus arctica* radula, figured by Robson (1931, fig. 58).

REFERENCES: *Octopus arcticus*, PROSCH, V., K. Danske Vid. Selsk. Skr., 1849, ser. 5, vol. I, 6, 53 and plate.

Bathypolypus arcticus, ROBSON, G. C., Monogr. Recent Cephalop. Brit. Mus. Coll., pt. II, p. 286, pl. 6, figs. 1-2, text fig. 30b, also 53-60 (with extensive synonymy).



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